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An empirical analysis of the effectiveness of design-build construction contracts: based upon projects executed by the Naval Facilities Engineering Command.

Mouritsen, John W.

AN EMPIRICAL ANALYSIS OF THE EFFECTIVENESS OF DESIGN-BUILD CONSTRUCTION CONTRACTS

BASED UPON PROJECTS EXECUTED BY

THE NAVAL FACILITIES ENGINEERING COMMAND

BY

JOHN W. MOURITSEN

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CONSTRUCTION ENGINEERING & MANAGEMENT
PURDUE ■ UNIVERSITY

Division of Construction Engineering and Management
School of Civil Engineering
Purdue University
West Lafayette, Indiana 47907

AN EMPIRICAL ANALYSIS OF THE EFFECTIVENESS OF DESIGN-BUILD CONSTRUCTION CONTRACTS

BASED UPON

PROJECTS EXECUTED BY THE NAVAL FACILITIES ENGINEERING COMMAND

AN INDEPENDENT RESEARCH STUDY
SUBMITTED TO THE FACULTY OF THE

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BY

JOHN W. MOURITSEN

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APPROVED:

_____
Professor Bobby G. McCullouch
Chairman, Advisory Committee

_____
Professor Lloyd S. Jones
Member, Advisory Committee

_____
Professor Jorge Vanegas
Member, Advisory Committee

ABSTRACT

Although the use of Design/Build as a construction project delivery method is quite common in private industry, it is a fairly recent phenomenon in the public sector. Further, while anecdotal reports of cost and time savings abound, little if any research has been published to date (as far as this author could determine) which would document evidence of quantifiable savings attributable solely to the use of design/build procedures. This apparent absence of reliable data on the subject could be explained by a reluctance on the part of private firms to release cost performance data which they may consider to be critical to their competitive advantage in the market.

This paper opens with a review of the development of design/build, then contrasts its features and benefits with traditional design/bid/build. Several types of design/build organizations are examined, with their relative advantages and disadvantages. The development of Federal Acquisition Regulations, and the government's historic reliance on competitive bidding is reviewed. The gradual acceptance by Federal Agencies of design/build contracts as a legitimate facilities procurement procedure is discussed in the context of these regulatory constraints.

The focus of the research is an in depth examination of the actual performance of two variations of design/build as currently implemented by the Navy. The Navy's 1.5 billion dollar annual construction volume, and the systematic execution of a number of programmatically identical projects during the same time frame provides a unique opportunity to examine the effects of design/build relative to control projects procured using traditional procedures. The results of this study indicate that despite unfamiliarity with a new program, and the learning curve effect, significant savings both in actual dollar expenditures, and in reduced project execution times are being achieved on a wide range of construction projects using design/build procurement methods.

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PREFACE

1. Context of the Problem

Although the use of Design/Build as a construction project delivery method is quite common in private industry, it is a fairly recent phenomenon in the public sector. ASCE reported that, "Despite substantial interest in Design/build by public owners, there are very few articles, journal papers and books that examine the subject." (Design/Build in the Federal Sector 1992) This paper opens with a review of the development of design/build, then contrasts its features and benefits with traditional design/bid/build. Several types of design/build organizations are examined, with their relative advantages and disadvantages. The development of Federal Acquisition Regulations, and the government's historic reliance on competitive bidding is reviewed. The gradual acceptance by Federal Agencies of design/build contracts as a legitimate facilities procurement procedure is discussed in the context of these regulatory constraints.

2. Problem Statement

Federal Agencies like their counterparts in the private sector are tired of cost overruns, late delivery, and claims against the owner resulting from errors, omissions and ambiguities in the plans and specifications. Many owners have turned to design/build as a means to increase life cycle value, while reducing delivery time and virtually eliminating change orders and litigation resulting from imperfections in the contract documents. However, until very recently most federal agencies did not have the latitude to freely implement innovative procurement strategies such as design/build.

While accounts of phenomenal cost and time savings abound in popular engineering journals, these reports are primarily anecdotal in nature, and offer no realistic means to make an objective comparison. Additionally, despite the clear theoretical advantages of placing full legal responsibility for the end product with a single contractual entity, empirical evidence to support this view has apparently not been collected, analyzed and published by professional organizations or in professional journals. The few published sources which address this topic have used subjective opinion surveys to analyze the effectiveness of design/build procurement strategies.

This apparent absence of empirical data on the subject could be explained by an understandable reluctance on the part of private firms to release cost performance data which they may consider to be critical to their competitive advantage in the market. However, as experience with design/build accumulates in the public sector, it should be possible to obtain solid data from government agencies which would allow objective analysis of quantifiable factors such as costs per unit for given building type, project delivery time, change order rates, and dispute and litigation records.

Additionally, problems unique to the Federal Sector, stemming from Federal Procurement Regulations and the Brooks Act work to restrain the use of design build. Furthermore, both AIA and AGC oppose the use of design/build for procurement of public projects, for varying reasons. The AIA feels that design/build often allows procurement of design services without regard to the "qualifications and competence" of the A/E as required by the Brooks Act. They object to the procurement of design services where price is the predominant factor, which is a predictable result

when the A/E selection process is turned over to the contractor. The AGC by contrast objects to the use of design/build for public projects because it is viewed by the construction community as anti-competitive. This view stems from the fact that award is often based on factors other than price, which means the low bidder doesn't necessarily get the award. Thus the challenge would be to find a design/build mechanism which overcomes the objections of both the A/E and construction communities, while still satisfying the needs of owners and public agencies.

3. Research Objectives

The initial objective of the research was to answer three fundamental questions:

1. Are the reports of enormous savings achieved through design/build legitimate, and if so, where are these alleged savings coming from? After all, there is no free lunch in this world.
2. Can these reported saving in time, cost and reduced litigation be substantiated using empirical methods or analysis of data currently available through public agencies?
3. If significant quantifiable savings are in fact achievable through the use of design/build methods, then why not remove all artificial or bureaucratic barriers, restraints and limitations and allow full utilization of these techniques in order to maximize effective use of public tax dollars.

The focus of the research is an in depth examination of the actual performance of two variations of design/build as currently implemented by the Navy. The Navy's 1.5 billion dollar annual construction volume, and the systematic execution of a number of programmatically identical projects during the same time frame provides a unique opportunity to examine the effects of design/build relative to control projects procured using traditional procedures.

4. Research Methodology

4.1 Source and scope of data used for the Analysis.

1. Data will be from NAVFAC's Construction Management Information System (CMIS)
2. Scope of data will be all MILCON projects programmed at $500,000 or more.
3. Projects having no comparable control project will be excluded from consideration.

4.2 Methodology used to estimate average savings.

1. Savings will be calculated using a simple ratio of actual cost over budgeted amount.
2. Actual cost is original design & construction award amount plus all change orders.
3. Budget is the Programmed Amount, which is a parametric estimate used for budgeting.
4. Programmed amount was determined before procurement method was chosen
5. Projects will be compared for the same year, or inflation will be factored in.
6. Geographic index factors are built into the original cost estimate which is site specific.
7. Total savings will be the ratio of the sum of actual over budget for all such projects.
8. Net Savings for design/build have the traditional method savings subtracted out.

5. Research Contribution

The results of this study indicate that despite unfamiliarity and experimentation with new procurement techniques, and the learning curve effect, significant savings both in actual dollar expenditures, and in reduced project execution times are being achieved on a wide range of construction projects using design/build procurement methods.

Growing pressure to reduce the Federal deficit and downsize the Department of Defense will force a reduction in many agency budgets while demanding the most effective use of scarce dollars. Likewise, reduced staffing in government agencies will force more efficient use of personnel resources. Most Federal agencies also have to deal with a unique requirement to execute (use or loose) funds prior to the end of each Fiscal Year (FY), which ends on the 30th of September. This paper also challenges the prevalent philosophy that design/build is only appropriate for fairly simple construction such as office buildings, family housing, etc. Recent reports issued by both ASCE and the FCC conclude that there is no valid reason to limit use of Design/Build to simple construction. Further surveys of Federal Agencies indicate successful implementation on a wide variety of building types with a broad spectrum of programmatic and technical complexity.

If the findings of this research are in fact borne out, and the trend toward design/build in the Federal sector continues, we might eventually reach a reversal in the traditional design/bid/build mindset. Perhaps, as predicted by the CII Task Force 2000, we will arrive at a situation in which design/build is the default condition, and the older conventional methods would be used only where it could be justified. Such extensive use of design/build strategies in the federal government, if implemented across a broader spectrum of building types could result in annual savings in the range of several billions of dollars annually, based on reported facilities expenditures of the 10 agencies responding to the ASCE survey alone. Assuming a 15% savings, which appears to be fairly conservative based on the results of this research, the facilities construction contracts of the 10 agencies totaling over $18 billion would generate savings of

approximately $2.7 billion annually. This magnitude of change cannot be expected to occur independently within each agency, but will require congressional intervention to redirect the enormous momentum created by decades of adverse bureaucratic regulations and procedures.

It is hoped that this paper will contribute to the growing awareness that design/build is no longer simply a maverick sideshow or special gimmick for simple construction, but a legitimate, mainstream contracting procedure applicable to the vast majority of building types. Perhaps with the foundation provided by this research, and additional studies based on other empirical evidence, it will become increasingly apparent that design/build is a facilities procurement strategy which is capable of delivering more building for the money, in less time, and with reduced claims and litigation.

Chapter 1 - Design/Build in the Construction Industry

1.1 Description of Design/Build Concept

The concept behind design/build construction is as its name implies; it means that a single contractual entity is responsible for both the design and the construction of a facility. Although there are various other contractual arrangements for project delivery, and several different forms of design/build arrangements, the essential element of design/build is the idea that there is only one party directly responsible to the owner for every aspect of the project. The simplicity and directness of this concept creates much of its appeal, particularly for those who feel the traditional design/bid/build system has failed to deliver its implicit promise of best value for the dollar.

The single source of responsibility uniquely characteristic of Design/Build contrasts sharply with the adversarial problems and lack of accountability often associated with the traditional system. The traditional project delivery triad is composed of owner, design professional and construction contractor, each with a different agenda and opposing profit motives. The owner typically first hires the design professional to prepare contract documents which will later form the basis for competitive bidding amongst construction contractors. After the design is complete, the contract is normally awarded to the low bidder. Although this system was accepted almost exclusively for many years as the primary method of construction project delivery, it has recently been challenged by nontraditional project delivery methods offering greater control over cost, quality and schedule. To more clearly contrast the functional distinction between traditional project delivery and the design/build method, compare the contractual and operational flow diagrams in Figures

1.1 and 1.2 illustrated below.

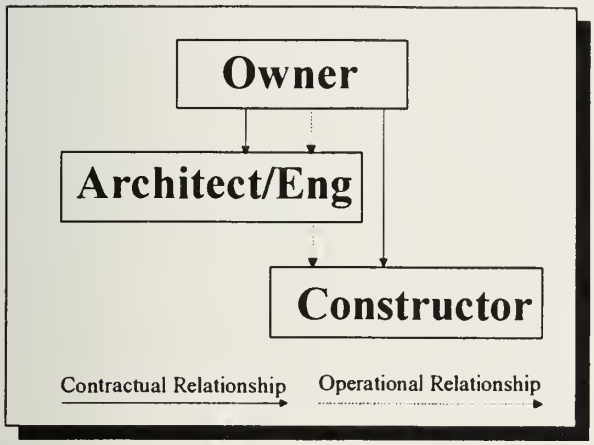

Figure 1.1 Traditional Method

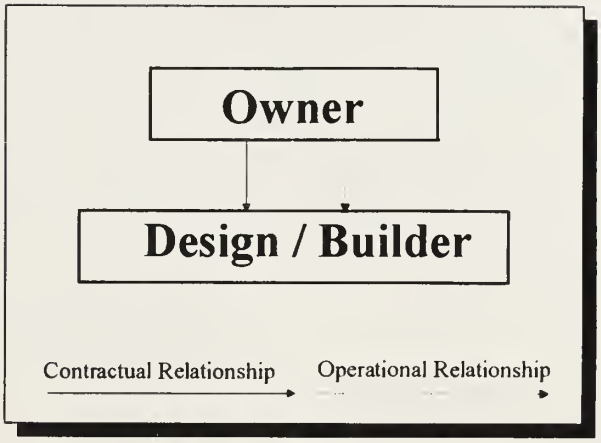

Figure 1.2 Design/Build Method

To further clarify how design build differs from other delivery systems, it is necessary to briefly describe other delivery systems that are sometimes confused with design/build. The term ***"Turnkey"*** has sometimes been loosely used as a synonym for design/build. A more precise definition of the term recognizes that Turnkey is actually an extension or vertical integration of the design/build concept both upstream beyond design and downstream beyond construction.

According to the author of "Understanding the Legal Aspects of Design/Build", a ***turnkey contract*** provides a much more "comprehensive set of project-related services...which may (also) include: Financing the project, identifying and procuring the construction site and site data, obtaining regulatory permits, designing and constructing the project (typical design/build), operating and maintaining the facility..." (Twomey 1989)

"fast-track" construction. This project delivery system does not address the contractual relationships between the owner, builder and architect, but rather refers to the sequencing of design and construction activities. The idea behind fast-track construction is to reduce project execution time by implementing a parallel design and construction strategy such that certain phases of the construction process can begin while others systems are still in the design phase. For example, items such as site work and foundations can typically begin construction while design work continues on such items as mechanical and electrical systems.

Although this concept is distinct from design/build, it should be noted that the "...design/build method of project delivery accommodates fast track construction activities more easily than other methods of project delivery...since the close communication between design professional and contractor inherent in the design/build arrangement enables different portions of the project to proceed at different rates with a minimum of confusion and conflict." (Twomey 1989)

Construction Management (CM) is another method of project delivery which was introduced in the "middle to late sixties" as an alternative to the traditional method. (Branca 1987) When using CM, the owner adds a fourth party to the triad of owner, A/E and contractor to maintain control over project cost and schedule. The CM Committee of ASCE states that, "The attribute that separates CM from other methods of managing construction such as design-build...is the *professional relationship of the CM as an agent of the owner* looking out for the owner's interests from the earliest stages of the project to completion." (Constructability 1991)

1.2 Historical Origins of Design/Build Construction

The practice of design/build can be traced back to antiquity, when, according to Twomey, "The master builder was usually both the designer and the assembler of the projects he envisioned... Throughout the (construction) process, (laborers and craftsmen) were controlled by the individual responsible for the project's design. Often, the "plans" were little more than an image in the designer's mind, realized only in the course of actual construction."

Anthony Branca adds his perception of the process in "Cost Effective Design/Build Construction" (1987), "Financing the work and securing the work force for early construction was achieved primarily through conquest...The owner then hired the master builder who acted as architect, engineer, and contractor for the project. With the dissolution of conquering forces such as the Roman Empire, patrons no longer had an unlimited supply of material and labor with which to build...Unlike their predecessors who had the means to build on a grand scale, the master builders now had to forecast costs... a difficult task for projects spanning decades and longer."

1.3 Development of the Traditional Design/Bid/Build System

As society evolved toward a more egalitarian economy, experienced "master builders entered the marketplace...competition was inevitable, a new construction method evolved-lump sum bidding. The proliferation and diversification of construction technologies lead to a need for greater specialization. To establish standard value and further control, a designer was commissioned independently to design the project. The competitive and capitalist American economy was well suited to the lump sum bid method, which became the standard." (Branca 1987)

1.4 Problems Associated with the Traditional Project Delivery System

In the late 1950's, "...certain shortcomings in this method had begun to appear....As inflation forced costs up, time became a valuable commodity and the inefficiencies of the lump sum bid method grew more expensive." (Branca 1987) A recent "Industry Focus" article in the Wall Street Journal stated, "US contractors are largely mired in decades-old practices fostered by a competitive-bid process that critics say discourages innovation and emphasizes cost over quality." (Carlton 1991) The traditional method of project delivery has also been blamed for the lack of integration between design and construction, and the resulting delays, cost overruns and disputes resulting in costly litigation.

Despite some inherent disadvantages in the low bid system, the more fundamental problem with the traditional method was the dichotomous nature of the owner's contractual relationships with the A/E and the construction contractor. This dichotomy remained an obstacle to full integration of the process and precluded either party from being held fully accountable for the end product. This problem was addressed in a paper presented at the ASCE Workshop on Quality in the Constructed Project by Weston Hester, Associate Professor at UC Berkley. He states, "The traditional approach to managing construction quality is to have the contractor warrant all work is in conformance with the contract documents and to have the engineer monitor the work in progress but to assume limited responsibility for its actual condition. But, with this approach, their responsibility to jointly resolve errors, ambiguities and misapplications of the standards for construction quality is carefully disclaimed...the careful circumscribing of the contractor's and engineer's respective roles is not working." (Hester - 1984)

Justin Sweet alludes to the resulting liability stating, "Courts often hold that the owner warrants the 'sufficiency' of its design" (Sweet 1989). Yet it is axiomatic in the construction industry that the idea of the perfect set of plans and specs, impervious to errors and omissions, is a myth believed by none but the most vain of architects and engineers. Even the best set of plans, when subjected to the vagaries of low bid contracting may be constructed by the most desperate (and perhaps least competent) contractor, who will undoubtedly find numerous inconsistencies, errors and omissions to justify changes which he hopes will make up for what he left on the table. Thus problems continued to develop with change orders and claims against the owner resulting from errors, omissions and ambiguities in the contract drawings and specifications.

This approach inevitably leads to contract disputes, delays, and unnecessary administrative effort in defensive actions and case building. These in turn often lead to a breakdown of the working relationship between owner, contractor and architect, low morale on the job, and more often than not, unresolved claims and costly and time consuming litigation.

The Business Roundtable's Construction Industry Cost Effectiveness Project (CICE), reported in 1983 that productivity had been plummeting in recent decades, construction costs had been skyrocketing, and "By every available measure, the United States no longer gets its money's worth in construction." (More Construction for the Money - 1991) European and Japanese construction firms have used the design/build strategy to increase their market share, while US firms have seen a commensurate decline in their overall market share. (Carlton 1991)

When the liability crisis is mentioned, many people think of medical malpractice suits as the number one problem, but a larger factor in the explosion of litigation is the result of claims against design professionals. The frequency of suits against A/E's is higher than that of suits against doctors, which seems inconsistent in light of the vast amount of publicity and attention given to the medical liability problem. In fact the frequency of claims against design professionals has doubled since 1970 when the problem was already becoming a serious concern. (Engineers 1988). Further, 1988 claims statistics revealed that design professionals and their insurers spend on the average, $28,172 per claim in addition to 125 hours of design personnel time. (Schapker-1990)

Admittedly, great efforts have been made recently to somehow contain this litigation explosion, using better communication and cooperation techniques such as partnering, which has become quite popular recently for many of the same reasons. Unfortunately, this approach does not alter the fundamental motives of the parties involved which quite naturally are profit driven. As long as the nature of the contractual mechanism for project delivery results in "the clashing of harsh contract language...(and) the forceful separation of the designer and contractor by their respective contracts", the motives of the respective parties will remain diametrically opposed. (Hester 1984) As a result the potential for conflict will remain, and when the big dollar disputes arise due to apparent errors & omissions in the plans and specifications, the parties will be obliged to protect their interests and will resort to litigation to do so if necessary. "Since partnering is implemented within the design/bid/build system, it is ultimately reduced to a mechanism for inflicting a sense of guilt upon the team member who weakens to the temptation of change order driven profit." (Whitlock 1992)

These problems are the natural result of a delivery system which pits parties against each other and allows both the A/E and the contractor to avoid full responsibility for their actions. To solve these problems it is necessary to look to the root of the problem rather than to merely attempt to treat the symptoms.

1.5 Reemergence of Design/Build as a Force in the Modern Construction Industry

These problems and the attendant dissatisfaction with progress in the construction industry set the stage for the development and acceptance of design/build in the US construction industry. During the inflationary decades of the 60's and 70's, there was a growing need to find faster and more effective methods to streamline the design and construction process. This impetus gave rise to innovations such as the introduction of the professional construction manager as the project coordinator, the utilization of fast-track construction sequencing, and the reemergence of design/build as a modern contractual strategy for construction project delivery.

"With design/build, complete and detailed working drawings were not needed before construction could start, and thus valuable time and money could be saved. The project's designer could work with the design/build staff as a team, performing the same functions that were once the domain of the Master Builder." (Branca 1987)

1.6 Advantages and Disadvantages of Design/Build

The design-build concept removes the pretext for the common "bid low and make it up on changes and claims" philosophy which seems to permeate the construction industry. The reason

for this is that the design/build entity which contracts with the owner to construct the project is fully responsible for the design and the construction, and therefore has no one to blame but itself for mistakes. Furthermore, the process of resolving any such changes is simplified since the responsibility and control are vested in the design-build agent.

In a recent article by Todd L. Whitlock, Director of Marketing for Charles Pankow, he points out that design-build is the standard in virtually every other US industry, "from televisions to aircraft carriers", and questions the motives of those who oppose its use in the construction industry. He compares the predicament of the traditional owner with that of a consumer in a world where all manufactured products were produced by industries as fragmented as the construction industry. "Its hard to imagine having to contractually pay five different entities from the purchase of a television set (i.e., design, engineering, parts production, assembly, and sales). Who do you go to when your new set malfunctions?" He goes on to list the three primary advantages he sees in the design-build delivery system, "The appeal of design-build lies in its ability to control spiraling costs, establish an effective system of risk management and maintain efficient and dependable project schedules." He believes the consumer is best served by this system, because with design-build, "The buyer purchases from a single source, leaving no opportunity for adversarial finger pointing to shirk the responsibility of a non-performing product." (Whitlock 1992)

The proponents of design/build maintain that there are certain distinct advantages and disadvantages depending on your perspective and contractual position. These pros and cons should be considered by each party contemplating entering into such a contract. The following list, which was suggested by Twomey, examines these advantages and disadvantages from the

owner's perspective. (Twomey 1989)

The following advantages may be obtained through the use of design/build strategy:

1. Reduction in Total Project Delivery Time
2. Reduction in Total Project Cost
3. Single Source of Responsibility-Facilitates Administration and Coordination
4. More inventive design/construction solutions (thru cooperation of Contractor & A/E)
5. Reduction in Project Management Stress
6. Reduced Incidence of Claims against the owner resulting from errors in plans & Specs

From the contractor's perspective, the following advantages may be obtained through the use of design/build strategy:

1. Increased control over the Project
2. Greater Job Satisfaction
3. Minimizing Risk and Project Uncertainty
4. Improved Communication with the Design Professional
5. Opportunity to Increase Profits (Shorter duration, more control)
6. Reduced Involvement in claims preparation and litigation.

In addition to the above mentioned advantages, Design/Build allows maximum integration of design and construction using constructibility principles. Constructibility has been defined as,

"disciplined, systematic optimization of the construction related aspects of a project during the planning, design, procurement, construction, test and start-up phases by knowledgeable, experienced construction personnel who are part of a project team." (Constructibility 1991) This very laudable goal is rarely achieved using conventional procurement methods, but becomes much more natural and achievable when designer and constructor are already members of the same team by virtue of a contract mechanism such as design/build.

The primary objection raised by opponents to the design/build approach is that it removes the historical checks and balances which protected the owner's interests under the traditional delivery system. Design/build is most susceptible to this problem when the contractual agent is a contractor rather than an A/E or joint venture, which is the most common approach. (Cushman/Taub 1992) Some have referred to this type of design/build arrangement as, "placing the fox in charge of the hen house." (Briggs 1992)

The fact that contractors typically have much greater latitude with respect to design options is indisputable. The question is, does this alleged weakness in the design/build concept actually result in a lower quality product for the owner. And if so, is there a technique to eliminate this vulnerability without sacrificing the entire concept. In fact, it could be argued that this increased latitude in design at the field level should result in better constructibility, and is undoubtedly among the primary reasons for the reported savings both in cost and time. The contractor can use systems he is most familiar with, or that are most easily available or cost effective on the market at that time.

Integrating design and construction services may have benefits, but there are risks, claims Joseph D. N'accaro, senior vice-president of Leo A Daly. He says that it, "absolutely does diminish checks and balances and for that reason should be viewed with suspicion," (Krizan 1993)

Even the most strident advocates of Design/Build admit there are disadvantages. Several disadvantages for the owner and contractor according to Twomey are listed below. (Twomey - 1989) For the owner, those disadvantages might include:

1. Loss of Design Professional as an Independent Professional Advisor.
2. Reduced Design Quality
3. Loss of Checks and Balances during construction (no independent oversight)

The possible disadvantages to the contractor include:

1. Gaps in insurance coverage & increased insurance premiums
2. Increased risk of nonpayment (especially during design phase)
3. Assumption of Responsibility for the acts & omissions of the design professional
4. Loss of certain legal defenses

1.7 Various types of Design/Build Strategies

Although numerous variations have been identified, the most prevalent design/build arrangement appears to be a construction contractor assuming the role of design/builder, hiring an architect as subcontractor to do the design, either before or after award of the contract. This tendency is

noted by Cushman/Taub as follows: "It is presumed that the design-build entity is fronted by a licensed contractor, providing the owner with a design prepared by a licensed A/E, who is acting as a subcontractor to or joint venture partner with the contractor. Contractors tend to dominate design-build teams because of their greater bonding capacity and willingness to accept risks." (Cushman/Taub 1992) There are four major categories of design/build strategies which are distinguished by their organizational structures. (Twomey 1989) Although the possibility of a professional construction manager (P/CM), was not included by Twomey among the four types, the resulting advantages and disadvantages would closely parallel those of Type B for a constructor as the design/builder. These four types of design/build strategies or organizational structures can be designated Types A through D for purposes of discussion:

1. Type A: Design professional is the design/build contractor
2. Type B: Constructor (or P/CM) is the design/build contractor
3. Type C: Joint-Venture between constructor and A/E is design/build contractor
4. Type D: Design/build organization contains both capabilities in house

Each organizational structure brings with it unique strengths and weaknesses which can be viewed as characteristic advantages and/or disadvantages for each member of the traditional triad of owner, design professional and constructor. Twomey has devised such a matrix of these advantages and disadvantages which are included for reference on the following three pages as Figures 1.3 through 1.5:

Advantages to the Client of the Design/Build Method

Advantages	Type A	Type B	Type C	Type D
Reduction in Total Project Delivery Time	✓	✓	✓	✓
Reduction in Total Project Costs	✓	✓	✓	✓
Single Source of Responsibility	✓	✓	✓	✓
Inventive Design Solutions	✓	✓	✓	✓
Reduction in Project Management Stress	✓	✓	✓	✓
Reducing the Incidence of Claims Through Negotiation	✓	✓	✓	✓
"Independent Professional Advisor" to the Client	✓			
Emphasis on Construction Management		✓		
Direct Access to Both the Design Professional and Contractor			✓	
Experienced Internal Management Structure				✓
Design/Build with a Proven Track Record				✓
Efficient In-House Communication				✓

Disadvantages to the Client of the Design/Build Method

Disadvantages	Type A	Type B	Type C	Type D
Loss of Design Professional as Independent Professional Advisor	✓	✓	✓	✓
Limited Connection with the Party Responsible for Construction Management	✓			
Reduction in Design Quality		✓		
Fractured Management Structure			✓	
Inflexibility to Meet Specific Project's Needs				✓

Table 1.3 Matrix of Advantages/Disadvantages for Owner

Advantages to the Contractor of the Design/Build Method

Advantages	Type A	Type B	Type C	Type D
Increased Control Over the Project		✓	✓	✓
Greater Job Satisfaction		✓	✓	✓
Minimizing Risk and Project Uncertainty	✓	✓	✓	✓
Improved Communication with the Design Professional	✓	✓	✓	✓
Opportunity to Increase Profits	✓	✓	✓	✓
Selection of Most Appropriate Design Professional		✓		
Reducing In-House Staff		✓		
Increased Marketing Strength			✓	✓
Fostering Team Spirit				✓
Evaluating Cost, Schedule, and Quality Issues				✓

Disadvantages to the Contractor of the Design/Build Method

Disadvantages	Type A	Type B	Type C	Type D
Gaps In Insurance Coverage		✓	✓	✓
Increased Risk of Nonpayment	✓			
Decreased Authority and Credibility with the Client	✓			
Responsibility for the Acts and Omissions of the Design Professional		✓	✓	✓
Loss of Certain Legal Defenses		✓	✓	✓
Difficult Issues of Management and Control			✓	✓
Joint and Several Responsibility			✓	
Complex and Time-Consuming to Establish			✓	✓

Table 1.4 Matrix of Advantages/Disadvantages for Contractor

Advantages to the Design Professional of the Design/Build Method

Advantages	Type A	Type B	Type C	Type D
Greater Control Over Project Quality	✓		✓	✓
Increased Level of Job Satisfaction	✓		✓	✓
Opportunity to Increase Profits	✓	✓	✓	✓
Field Experience	✓		✓	✓
Greater Credibility with Clients	✓		✓	✓
Reducing the Incidence of Claims by Contractors	✓	✓	✓	✓
Selection of the Most Qualified Contractor	✓			
"Least Effort/Least Risk"		✓		
Sharing Control Over the Project			✓	✓
Increased Marketability	✓		✓	✓
Fostering Team Spirit				✓

Disadvantages to the Design Professional of the Design/Build Method

Disadvantages	Type A	Type B	Type C	Type D
Responsibility for the Acts and Omissions of the Contractor	✓		✓	
Gaps in Insurance Coverage	✓		✓	
Large Start-up Costs	✓			✓
Decline in Status	✓	✓	✓	✓
Assuming the Burden of Construction Management	✓			
Reducing the Scope of Design Services		✓		
Isolation from the Client		✓		
Conflicting Obligations		✓	✓	
Difficulty Establishing Management and Control			✓	
Joint and Several Responsibility			✓	
Difficulty Establishing the Design/Build Organization				✓

Table 1.5 Matrix of Advantages/Disadvantages for A/E

1.8 Current Design/Build Trends in the Construction Industry

In an article entitled, "Cut Construction Costs on New Facilities, the author states, "The design-build contract is gaining ground as the construction method of choice." (Thebault 1989) In a November 91 issue of Engineering News Record, Nadine Post reported that, "More firms are using the design-build concept because there are fewer parties to coordinate." (Post 1991) There are others, of course, who have taken a more agnostic view as expressed by the following statement published in the Real Estate Finance Journal, "It seems that every time there is trouble in the construction and real estate industry, design-build has a resurgence." (Rosenzweig 1992)

According to Building Design & Construction, the top 3 design/build firms had nearly tripled their design/build work between 1986 and 1990. (Courtillet 1992). Figure 1.6 Shows the trend in the use of Design/Build based on ENR Top 400 Construction Volume Surveys from 1987 to 1993:

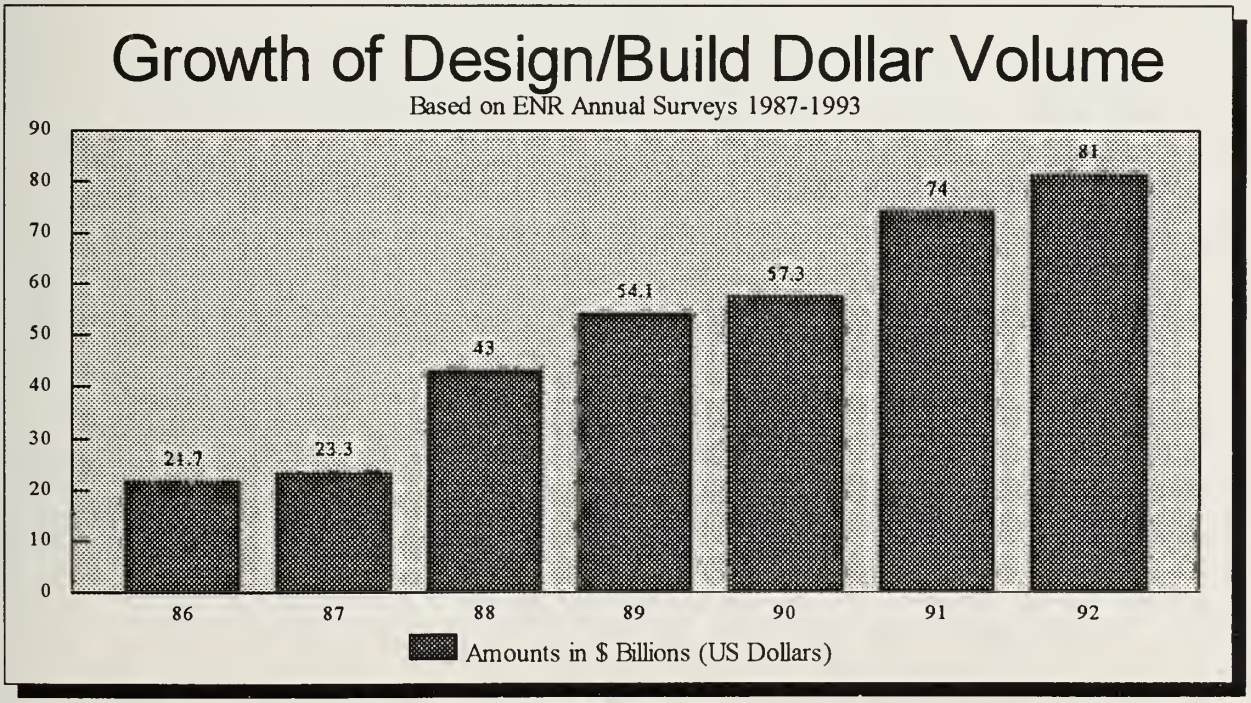

Figure 1.6 Histogram of Design/Build Growth from 1986 - 1992.

The growth in the annual dollar volume of design/build contracts indicates a remarkable 400% increase in the six years since 1986. Obviously, this increase cannot be wholly attributed to the increasing popularity of design/build alone, since the entire construction industry saw fairly strong growth in volume during this period as well. Figure 1.7 below illustrates the growth of design/build as a proportion of the construction volume in the construction industry as a whole:

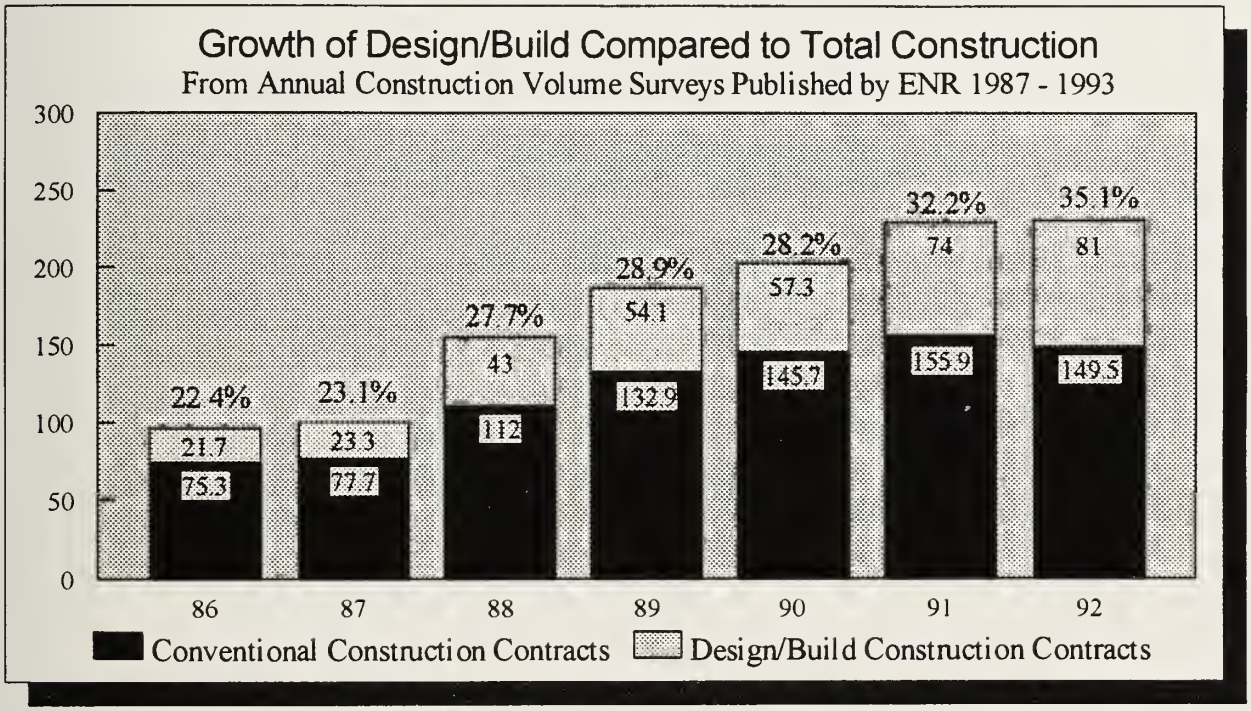

Figure 1.7 Design/Build as Proportion of All Construction

As can be seen from the chart in Figure 1.7, the Design/Build share of the market has increased from 23.1% to 35.1% since 1987. This represents an increase of 52% in the popularity of design/build in the last five years alone. The reason for this strong growth in the design/build area is found in the advantages that owners see in obtaining faster delivery, and reducing cost overruns and claims by having a single source of responsibility.

According to Bechtel's Friend, the trend toward using design-build firms among owners is accelerating rapidly. "I see a strengthening of it. It is central to being able to integrate the whole work process," he explains. Friend claims that, "Most owners today want one-stop responsibility for projects." James Moynihan, president of Heer T. International Inc. said, "We're seeing it all over the country. A lot of pure architect-engineers (AEs) don't like it. I see it as an opportunity." According to Moynihan, owners "are tired of having to deal with 40 consultants."

1.9 Current Design/Build Trends in the Public Sector

In an article entitled "Design-Build goes Public", Mr. James Denning states, "The public sector is looking for methods that deliver faster and cheaper than traditional methods. They may have found it in a "new" concept that has been a hot topic in the private sector for several years: design-build." (Denning 1992) One approach used frequently by several federal agencies recently is to request proposals based on a specific set of performance criteria. Proposers will provide designs prepared to the 30% level with a guaranteed maximum price. The agency then "selects a firm, typical on a combination of price, design and technical merit." The additional flexibility of design and better coordination between A/E and contractor create a situation that facilitates the use of fast track construction method which also speed project execution. (Denning 1992)

James Stewart , director of GSA's Office of Design and Construction states, "We get delivery up to a year earlier...It means we can cancel other leases and fulfill programs." State administrator have had similar experiences. Jack L. Brown, represented the State of Washington which recently completed a 240,000 SF Agriculture and Natural Resources building at a cost of $73 million. He

feels confident that public has been well served by the use of design-build. "I believe we've gotten more for our money, better architecture and delivery a year earlier." he says. He claims that design/build is "like a big ship. Once it gets in motion, you can't stop it" The momentum created by design/build is precisely why it keeps things on schedule. Jim Bradburn of Fentress Bradburn, a structural consulting firm says, "It puts a fair degree of restraint on the owner and the architect, but that's how you end up with a project that's within budget" (Denning 1992)

There are other unanticipated side effects in public sector design/build as well. For example, many who were content with the traditional system complain that the new process limits the opportunity for public comment on the project, since during the public phase when comments can be received there is really nothing of substance to comment on other than the program and performance requirements. There typically will not be any drawings to critique prior to the request for proposals. Most agencies are unwilling to open up the selection process to the public. Another issue that can become a problem for public agencies using design-build is the funding aspect. Government agencies are often unprepared for the result of a faster start and quicker execution, which requires the owner to pay for the building much sooner than expected. The Postal Service representative, Mr. Wiernicki, stated, "If we wanted to go totally with design-build, we would need a lot more money up front. Currently, they plan to use design-build for approximately 30% of their construction budget. (Denning 1992)

There appears to be a definite movement among federal agencies toward the use of design/build. Larry Spiller, staff director of the Professional Engineers in Private Practice (PEPP) division of

the National Society of Professional Engineers (NSPE), stated, "There seems to be a growing interest by the federal agencies in design-build". This was borne out by statements of panelists at the annual NSPE convention held during January of 1992 in Charleston, SC. Guest panelists representing GSA, NAVFAC, and the US Postal Service were in attendance at the convention. (Edmunds 1992)

Harry Zimmerman, Assistant Commander for Engineering and Design of NAVFACENGCOM, was enthusiastic about their experience with design/build. He noted that the Navy has no fear of losing control of design/build projects because the Navy has highly qualified professional construction managers on the in house staff. Other participants appeared equally positive about design/build. GSA's Director of Design and Construction, James B. Stewart stated, "GSA is taking the greater value approach and has gone from a prescriptive mode to a performance (specification system)". GSA currently has 200 projects being constructed through design/build contracts. R.Craig Auth, Contracting Officer for the US Postal Service, said that approximately 50% of their projects are being done using design/build procurement, and that "the Postal Service was happy with the results." (Edmunds 92)

Charles Pankow, founder and head of one of the most successful design-build contractors in the country has until recently focused primarily on private sector development projects. As a result of the slump in construction in recent years, Mr. Pankow is expressing great interest in public sector projects. He states, "We're seeing a number of public agencies going design-build because they're sick of the cost overruns." (Pankow 1992)

1.10 Reaction from A/E community to the Popularity of Design/Build

Design/Build has been the source of a good deal of controversy and debate among design professionals over the years, but the stakes have gone up with the recent public sector move toward design/build. The source of consternation is not too difficult to identify given the decreased role the A/E typically plays in the most influential decisions during the design/build process. In addition, the trend toward increased use of design/build as certainly had an adverse impact on those design firms which perform only in the traditional mode. Further the design proposals required to be competitive in the selection process are often very costly and risky endeavors for the A/E.

Until 1980, the AIA's official position was that it was unethical for an architect to participate in and profit from a design/build venture because they believed there was an inherent conflict of interest which would preclude the architect from performing professional services for the client in an unbiased fashion. (Cushman/Taub 1992) In 1985, when the AIA produced its Standard Forms of Agreement for Design/Build contracts, their position on government design/build was apparent from reading the instruction sheet for AIA document A191, Standard Form of Agreement between owner and design/builder: "AIA believes that if a public owner chooses to utilize the design/build process, selection of the design/build team should be based upon objective criteria developed to evaluate qualifications and competence of the design/build team, as with the Brooks Act procurement methods." The Brooks Act requires federal agencies to procure A/E services by negotiation based on qualifications and competence. The Brooks Act is more fully discussed in the following chapter.

The AIA stated its position in an open letter to GSA commenting on its proposal guide for its design/build program, "The AIA does not believe that the design/build method is a project delivery method that should be used in the public sector to the extent that it is now employed." (AIA Public Comments on GSA's draft Proposal Guide for Design/Build, 10 August 1990)

The AIA subsequently reiterated its position in a public policy statement on the issue of design/build in the public sector which includes the following statements: "The AIA strongly advocates the use of the traditional design/bid/build process of project delivery in the public sector....The AIA advocates the adoption by public agencies of qualifications-based selection procedures when the design/build method is used..." (AIA Design/Build Task Force in December 1990)

Other concerns as expressed in a report by the AIA Design/Build Task Force in December 1990 are summarized below:

1. Agencies don't get what they wanted because solicitation documents are misinterpreted.
2. Owner will experience lack of control over the design of the final product.
3. Undue financial burden on design/build entities to prepare expensive proposals
4. Evaluation of proposals requires tremendous effort from top level agency management.
5. Reviewers delay projects due to unfamiliarity with commercial/industry standards.
6. Potential Conflict of interest for architects involved with design/build.
7. Use of design/build conflicts with some state licensing laws.
8. Process could preclude qualifications-based A/E selection circumventing Brooks Act.
9. Reduces design professional's control over quality of the design
10. May detract from or eliminate direct relationship between client and designer.

While many of these concerns can be adequately addressed through proper policy and procedure, several of these issues are related to the inherent nature of design/build itself. For example, the architect involved in a design/build team no longer views himself as an unbiased professional agent representing the owners interest, since he either works for the contractor, or in a joint venture which will profit only to the extent that the project is built for less than the Guaranteed Maximum Price. Therefore price pressure commencing at project inception may limit design possibilities and reduce the design professional's control over the quality of design.

Many of these concerns are shared by other design professionals, especially those relating to the cost of proposals, the Brooks Act, and the relationship with client. These and other concerns regarding the risks of using design/build have been echoed by other professional organizations such as the ASCE . The ASCE policy statement on Design-Build in the Federal Sector (April 1992), includes the following list of recommendations for federal agencies using design/build:

1. Pre-selection based on the qualifications of the team, in the spirit of the Brooks Act.
2. Scope of work of sufficient detail to allow cost effective proposals by competing teams.
3. Clear selection criteria reinforcing qualifications-based selection process.
4. Reimbursement for the "short-listed" firms that are making full-fledged design proposals.
5. Assurance of direct line of communication between owner and design professional.

The fundamental issue seems to be the loss of control over the design process, as it is clearly an affront to a design professional to be given a subcontract for design by the contractor, especially if

this results in a loss of direct interaction with the client and reduced overall control of the design concept and development. But even the firms who have swallowed their pride on the control issue still object to the unfair burden of A/E's in preparing extensive design work for design/build proposals, often without compensation other than the outside chance of getting the job.

For example, the AIA Task Force on Design/Build conducted a survey in 1975 of 29 projects totaling $84 million and reported that the average expenditure was $19,800 per proposal or $5,200 per million dollars of construction. (Design/Build/Bid Task Force Report - 1975) In Florida, in the state Design/Build program, the chances of being selected are about 25%. (AIA Design/Build Task Force Meeting, January 1990)

Mr. David Lawson, chairman of the Task Force reported that during a Design/Build forum held May 21, 1991 he invited comments on Public use of Design/Build and one attendee stated that based on his experience, "Any design/build team must be prepared to advance the design to the 50% completion stage....in order to have a fair chance of being selected." (AIA Convention Notes - May 1990) Thus it is easy to see why A/E's might expect to be compensated for the considerable effort required to prepare the proposal.

Perhaps another reason for the traditional opposition of A/Es to design/build is the adverse effect on their share of the business: A/E's billings dropped from 11.8 to 7% of the Design/Build market. Architects dropped from 3.5% to 2% of the same market. "I'm not sure the pure engineering segment is viable anymore'! says an executive at a militant pure design firm that

declines to be identified. "The market is rushing headlong into the arms of EC (Engineering-Construction) firms. Some industry leaders are concerned about whether a pure engineering market even makes a lot of sense. (ENR - April 5, 1993)

"EC firms are expanding their dominance of the construction design market, according to this year's Top 500 survey, EC firms snagged 51% ($ 17.3 billion) of the total 1992 Top 500 billings, compared with 41.5% in 1991 and 36.7% in 1990. Engineers are the next largest group this year, winning 24%($8.0 billion) of 1992 billings. That group was followed by, engineer-architect firms at 15% ($4.9 billion), AEs at 7% ($2.3 billion), architects at 2% (826 million) and others at 1% ($406 million). As a percentage of Top 500 billings, AE's and architects have lost the most ground over the past three ENR surveys. (ENR 5 April 93)

For a number of reasons the design/build market seems to be dominated by construction rather than design led firms. Perhaps A/E's appear to the client to be less sensitive to the constant variations in material and labor cost trends, and the nuances of the construction market. This presumption appears to be an accurate reflection of the market and further reflects the A/E community's historic distrust of the design-build format. (Cushman/Taub 1992)

Some states have enthusiastically embraced design build, while others have interpreted their professional licensing laws and procurement regulations so as to indirectly prohibit the use of design/build. It has recently been reported, for instance, that the "New Jersey board of architects has, over the past 18 months, issued some 300 orders primarily barring contractors from using

the term "design-build" in advertisements." (Cushman/Taub 1992) New York, Texas and Pennsylvania also have experienced some controversy over this issue. In September of 1991, "Government officials in New York have issued a warning to all design professionals that seems to prohibit...design/build contracts. The state says that delegating design responsibility to unauthorized firms violates design profession board rules.....and criminal laws" (ENR September 1991)

In the next few years the development of legal precedent as well as statutory and case law regarding the use of design/build both at the state and Federal level will have an impact on growth and use of design/build by public agencies. The approach taken by the A/E community in each state and in congressional lobbying efforts will also be very influential in determining the final outcome of these issues.

Chapter 2 - Contract Procurement in the Federal Government

2.1 Background of Federal Procurement Law

Two years after the last state had ratified the constitution, Congress made provision in 1792 for all supplies needed by the War Department to be purchased by the Treasury Department. Shortly thereafter, in 1798, the War Department and the newly created Navy Department were given authority by Congress to make all of their procurements directly. However, it was not until 1809 that the first federal statute addressing specific procedural requirements for federal procurements appeared. It read in pertinent part, "...All purchases and contracts for supplies or services which are or may, according to law, be made by or under the direction of either the Secretary of the Treasury, the Secretary of War, or the Secretary of the Navy, shall be made, whether by open purchase, or by previously *advertising for proposals* respecting the same..." Although this apparently left broad latitude for discretion between the two methods by the contracting officer, the record indicates that, "Purchases were made by advertising (competitive bidding) except where public exigencies required immediate contract performance." (Werhle-Einhorn, Esq - 1988)

Between 1842 and 1852, further standards were added including specific length of time required for advertising, the presence of at least two witnesses during bid opening by procurement officer, and *requirement to award to the low bidder*. Thus, from the earliest record of contract procurement by the Federal Government, the standard has been to use competitive bidding of lump sum contracts, ostensibly to assure the widest possible selection of sources, and ensure the highest degree of price competition and fairness to bidders. This served to preclude the

appearance of undue influence by government officials in the selection process and to assure the tax paying public that their dollars were being spent in the most efficacious manner possible.

These procurement regulations and bidding requirements remained intact for almost a century until after the attack on Pearl Harbor. The demand for a quick response resulted in the passage of the First War Powers Act of 1941, which authorized agencies involved with the war effort to *enter into contracts without regard to existing laws* and regulations regarding procurement. Only a little over a year later, in March of 1942, all contracting by the formal advertising method *(competitive bidding) was prohibited* unless specially authorized!

Since the close of World War II, three principle statutes have governed the formation of federal government contracts; the Armed Services Procurement Act or "ASPA" (1947), the Federal Property and Administrative Services Act "FPASA" (1949), and the Office of Federal Procurement Policy Act "OFPPA". ASPA applied to DOD, NASA, and the Coast Guard, FPASA applied to civilian agencies and OFPPA applied to executive branch agencies in general. Each of these regulations had the effect of limiting the agencies to formal advertising (for competitive bids) "whenever feasible and practicable" with award being made "without discussions" to the "lowest responsive and responsible bidder." Although noncompetitive negotiations were supposedly tightly controlled by specific exceptions to the statutory requirement for formal advertising, in 1981 and 1982, over 60% of DOD procurements were made with sole-source contracts. (Werhle-Einhorn, Esq - 1988) There was also a perception that no distinction was being made between competitive negotiations, which is a legitimate

competitive procurement technique and sole-source procurements which is inherently non-competitive, and thus subject to abuse and criticism.

Congress sought to limit these perceived problems by imposing stringent restrictions on the award of noncompetitive (sole-source) contracts, and redefining procurement terminology more clearly. Congress amended these three statutes with the passage of Title VII of the Spending Reduction Act of 1984, popularly called the Competition in Contracting Act of 1984 (CICA) which was subsequently signed into law by the President in July of 1984. The new requirements for competitive negotiations were so restrictive, and the additional justifications and approval process so cumbersome, that this form of procurement was rarely used for construction contracts.

In June of 1986, the Blue Ribbon Commission on Defense Management reported to the President that, "Federal law governing procurement has become overwhelmingly complex. Each new statute adopted by congress has spawned more administrative regulation. ***As law and regulation have proliferated, defense acquistion has become ever more bureaucratic and encumbered...***" (A Quest for excellence - 1986)

2.2 Limiting Effect of Federal Procurement Law on Use of Design/Build Contracts

According to Park, Rogers and Sears who contributed the chapter on The Effect of Licensing laws on Design Build Projects, in the Design/Build Contracting Handbook, 1992, outside of certain statutory exceptions, "Federal law does not facilitate design-build contracting. In fact, it indirectly prohibits design-build contracts by specifying the ways in which the government will

procure A/E and contractor services. When design-build is permitted, the number of projects and freedom to contract are limited...." The most important constraint on the use of design-build contracts in the federal sector results from the federal procurement laws.

Traditionally, there were two basic premises which acted to preclude the use of design/build contracts, 1) The idea that competitive bidding was the best solution for every procurement requirement (with very few exceptions) implied that negotiated procurements were only to be used under extraordinary circumstances. 2) The use of competitive bidding for Architectural / Engineering services was specifically prohibited in favor of negotiations based on competence and qualifications. Thus, combining both construction, which had to be competitively bid with design which could not be competitively bid was a significant legal hurdle. Procurement of A/E services is still governed by the Brooks Act, 40 U.S.C. SS 541 in which Congress established federal policy as follows;

> "to negotiate contracts for architectural and engineering services on the basis of demonstrated competence and qualification for the type of professional services required and at a fair and reasonable price."

The Competition in Contracting Act on the other hand requires the use of competitive sealed bid procedures unless special conditions are met and adequate justification is provided to warrant an exception or waiver be granted. The Federal Acquisition Regulations (F.A.R.) provide, in pertinent part:

"(a) Contracting officers shall acquire construction using sealed bid procedures . except that sealed bidding need not be used for construction contracts outside the United States, its possessions, or Puerto Rico. (b) Contracting officers shall acquire architect -engineering services by negotiation, and select sources in accordance with applicable law, subpart 36.6 [of the F.A.R.], and agency regulations." (FAR 36.103)

Thus it was clearly the intent of congress that all Federal agencies utilize separate contracts for design and construction and that separate methods of procuring those contracts should be utilized. Park, Rogers and Sears stated that, "This procurement scheme establishes a preference for separate contracts by the United States with its A/E and with its contractor. Organizational conflict of interest regulations reinforce the separation of design work from follow-on construction." (Park, Rogers and Sears - 1992) The FAR substantiates this view by stating in pertinent part:

"If a contractor prepares and furnishes complete specifications covering nondevelopmental items, to be used in a competitive acquisition, that contractor shall not be allowed to furnish these items, either as a prime contractor or as a subcontractor, for a reasonable period of time, during the duration of the initial production contract." (FAR 9.505-2.a.1)

The Design/Build Contracting Handbook cites an interpretation of the FAR regulations by the comptroller general setting a precedent adverse to the use of design/build in the following case,

"A similar prohibition applies to the drafting of specifications for, and furnishing of equipment. These rules have been applied to the drafting of specifications for construction activities. For example, the comptroller general upheld the Air Force's disqualification of an operations and maintenance contractor, who participated in drafting the specifications, from participating in the procurement of construction of repairs and alterations at the same base." Quoting again from the FAR, 9.505-2(a)(1), it states in pertinent part,

> "An organizational conflict of interest exists when the nature of the work to be performed under a proposed Government contract may, without some restriction on future activities, (a) result in an unfair competitive advantage to a contractor or (b) impair the contractor's objectivity in performing the contract work."

While the intent to maintain a fair and unbiased atmosphere is clear, the unintended by-product of these regulations was to prohibit federal agencies from utilizing new and innovative contracting mechanisms such as design/build which were being successfully used in the private sector. Park, Rogers and Sears recognize the risks involved, but apparently conclude that the benefits of using design/build outweigh these risks: "Precluding a design contractor from performing the follow-on contract may help to avoid a situation in which the contractor could draft specifications favoring its own products or capabilities. Design-build projects may represent an "organizational conflict of interest," but the result of the process is intended to be a lower-priced final product." (Park, Rogers and Sears 1992)

The Design/Build Contracting Handbook makes the following distinction between process involved in a design/build procurement and the type of unfair advantage congress intended to prohibit, "In a conventional procurement, a contractor....who participated in developing the scope of work would have an advantage over other bidders because it had time to evaluate the work, whereas most bidders may not have had the time for a detailed review of the plans. The contractor with advance knowledge should also have a greater understanding of the risk factors. In contrast, design-build entity is responding to a negotiated procurement because each can evaluate the risks and benefits (in terms of constructibility) of its proposal and all are allotted the same time period to do so. The owner chooses from among the proposals, selecting the best combination of price and value. In other words, because factors other than price are relevant to design-build, design-build appears highly suited to negotiated procurements." (Park, Rogers and Sears - 1992)

2.3 The Impetus for Innovation in Federal Procurement

During the late 60's as the Vietnam war began to escalate, additional requirements for family housing for the growing military service was required. The conventional design/bid/build system was resulting in unacceptable housing quality, and costs overruns and change orders were exceeding allocated funding for construction. As the military build-up continued, news reports accumulated of outrageous prices being paid by the Department of Defense for standard commercially available items like hammers, toilet seats and bolts. The Waste, Fraud and Abuse Hotline was established to allow anonymous reporting of illegal procurement actions, and Congress demanded greater accountability from those responsible for procurement actions.

Congressional subcommittees began to scrutinize the contracting process for facilities acquisition, and wanted to know why the military could not utilize streamlined contracting procedures being used in the private sector to expedite procurement of design and construction services. As it turns out, the primary reason was the mountainous volumes of constraints mandated by congress which had grown into an impenetrable mass of bureaucratic red tape. Congress decided to allow some flexibility on a case by case basis to see if the military could duplicate successes being reported in the private sector using design/build techniques.

Congress began by allowing the services to procure family housing in a similar manner as the private sector. The services were directed in 1967 to prepare a plan whereby the existing speculative housing industry builders and developers could participate in a new approach which would solicit *proposals to be evaluated on quality* as well as price. The Navy developed a single-step source selection procedure based on price and quality, and the Air Force developed a procedure based on a two-step method which would then be awarded to the lowest bidder.

After three years of testing, the General Accounting Office reported in the Spring of 1970 that, "The experience of the Navy on development and construction of family housing using turnkey type procurement...has shown...comparable quality or better for the same cost..." This was a rather tentative endorsement to be sure, but by 1972 after having awarded some 30 projects using this method, the other services were directed to adopt the Navy's one-step source selection procedure for their family housing projects. That same year Congress also dropped the requirement for case-by-case congressional approval of design/build for each new family housing

project, although this special approval was still required for all other types of design/build construction projects.

By 1984, the tri-service reviews under the auspices of the Office of the Secretary of Defense was considered unneccessary, and each service was given full reign to develop and refine their own design/build family housing program. In 1985, the services were directed to test the design/build procurement method on three non-housing Military Construction (MILCON) projects. The Navy's response was to develop a unique brand of design/build which they called the "Newport Design/Build method." In addition, they chose to adapt the 1-step and 2-step method for use on several non-family housing projects. The result of these experiments will be discussed in the next few chapters. In 1986 the Commission on Defense Management reported that, "It is clear that major savings are possible...if DOD broadly emulates the acquisition procedures used in outstanding commercial programs." (A Quest for Excellence - 1986)

2.4 Current trends in Federal Facilities Procurement Contracting

A recent article in Building Design & Construction, states, "...government agencies are giving increased scrutiny to building delivery processes to achieve the fullest benefit from available resources." (Bordenaro 92) Perhaps it would be useful at this point to briefly review a survey of current trends within the Federal Agencies responsible for major facilities procurement programs.

In December of 1992, a survey of Federal and State agencies was conducted by Building Design & Construction to determine how many government agencies were using specific delivery

methods. The results indicated that 32%of the agencies surveyed used design/build. The other four methods in the poll were competitive bidding, which was used by 96% of the agencies, construction management at 32%, negotiated procurement at 28% and fast tracking, which was also used by 28%. (Bordenaro 92)

A survey of Design/Build utilization in 19 Federal Agencies was conducted in 1992 by the American Society of Civil Engineers. This survey provided more specific data on the actual dollar amount of facilities construction contract awards, and the portion of those awards made using design/build Of the 14 agencies responding to the survey, 4 were not currently using design/build, while the rest were at varying stages of implementation as reflected in the chart below:

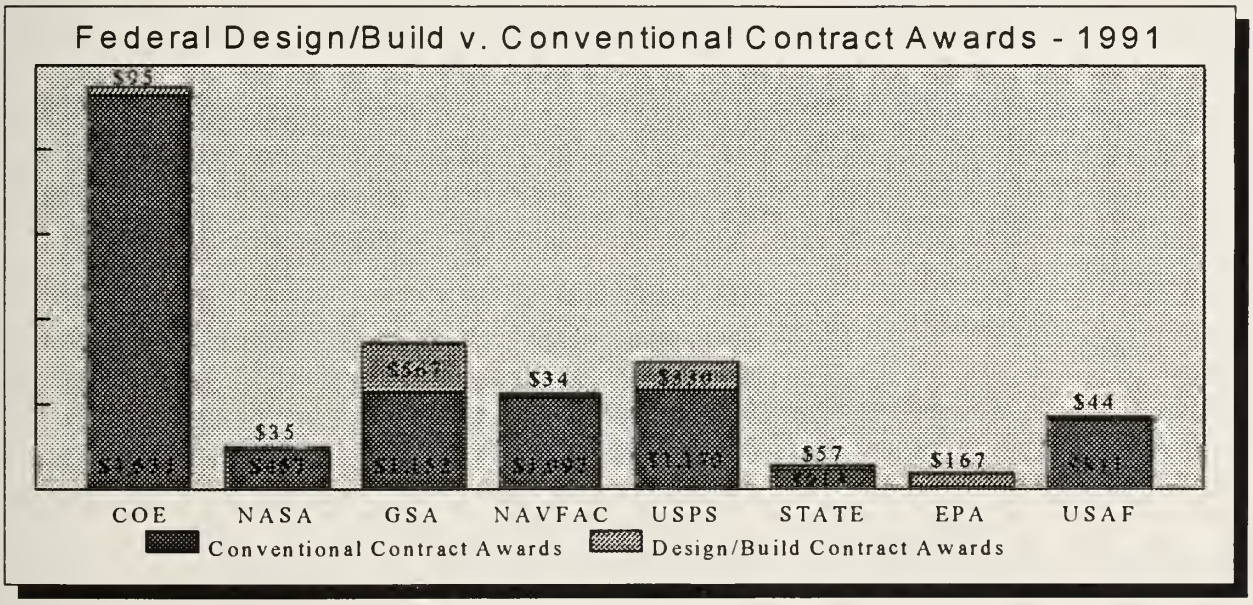

Figure 2.1 Federal Design/Build v. Conventional Contracts

The US State Department has recently constructed a $50 million embassy in the Arab Republic of Yemen which had a "pressing project occupancy date (which) had to be met". The design/build

approach was chosen for this facility because of the "ability to complete construction more quickly than traditional project delivery methods." The State Department plans to continue using design/build on similar projects over the next three to five years at an annual construction volume of approximately $70 million/year. (Twomey 1989)

After two trial projects in the early 1980's, GSA has issued a standard form of contract procurement for design/build services in March 1987. GSA which is one of the largest federal procurement agencies appears strongly committed to using the design/build approach in their construction programs. The most recent example is a three million square foot, multi-use International Cultural and Trade Center in Washington, DC, scheduled for full occupancy by 1996. (Twomey 1989) GSA uses negotiated contracts for "specialized and complex projects including all design/build projects, which GSA is using more often." Their construction budget for FY 92 was $1.1 Billion, with expectations that it will remain "high for the next few years as the agency plans to own more of its facilities instead of leasing them" (Bordenaro 92)

The US Postal Service completed its first design/build project in 1989, when it constructed a 700,000 SF $82 million general mail facility in Washington, DC. A similar facility was recently completed recently in Indianapolis. The Postal Service has indicated plans to continue using the design/build for selected new facilities over $10 million. (Twomey 1989) Their construction budget for FY 92 was $910 million, of which "Design/build contracts were awarded for 25% of the projects." (Bordenaro 92) This year, R.Craig Auth, Contracting Officer for the US Postal Service, said that approximately 50% of their projects are being done using design/build

procurement, and that "the Postal Service was happy with the results." (Edmunds 92)

The Army Corps of Engineers, following special congressional authorization, awarded an $18 million medial clinic at Kirkland Air Force Base in Albuquerque, NM and a $13 million alternate communications facility for the Department of State. They are currently considering using design/build procurement for a number of facilities including physical fitness centers, commissaries, fire stations, instruction buildings, warehouses, and administration buildings.

2.5 Factors Affecting Federal Agencies Choice to Use Design/Build Contracts

The Federal Construction Council, Consulting Committee on Cost Engineering recently published the results of a survey in which seven federal agencies using design/build provided data on 27 projects which were reprentative of their experiences with design/build. They also responded to qualitative survey questions comparing these projects with similar ones done using conventional techniques.

One of the most interesting aspects of the survey conducted by the Federal Construction Council was an investigation of the reasons federal agencies selected Design/Build. This was of particular interest for two reasons; 1) Federal agencies may have different objectives and motives than the private sector, and, 2) The reasons given by each of the agencies may reflect differing expectations of what the design/build method can offer, and how it might improve their respective procurement processes. The results of this survey have been categorized into six broad areas which included expected impact in terms of the following factors:

1) Fewer Claims

2) Quality improvements

3) Reduction in Project Execution Time

4) Reduction in Total Project Cost

5) To Test Design/Build Results

6) Because of enormous size of Project

The survey results have been tabulated and summarized in the graph on the following page indicating the relative weight given each factor for each of the seven agencies responding to the survey.

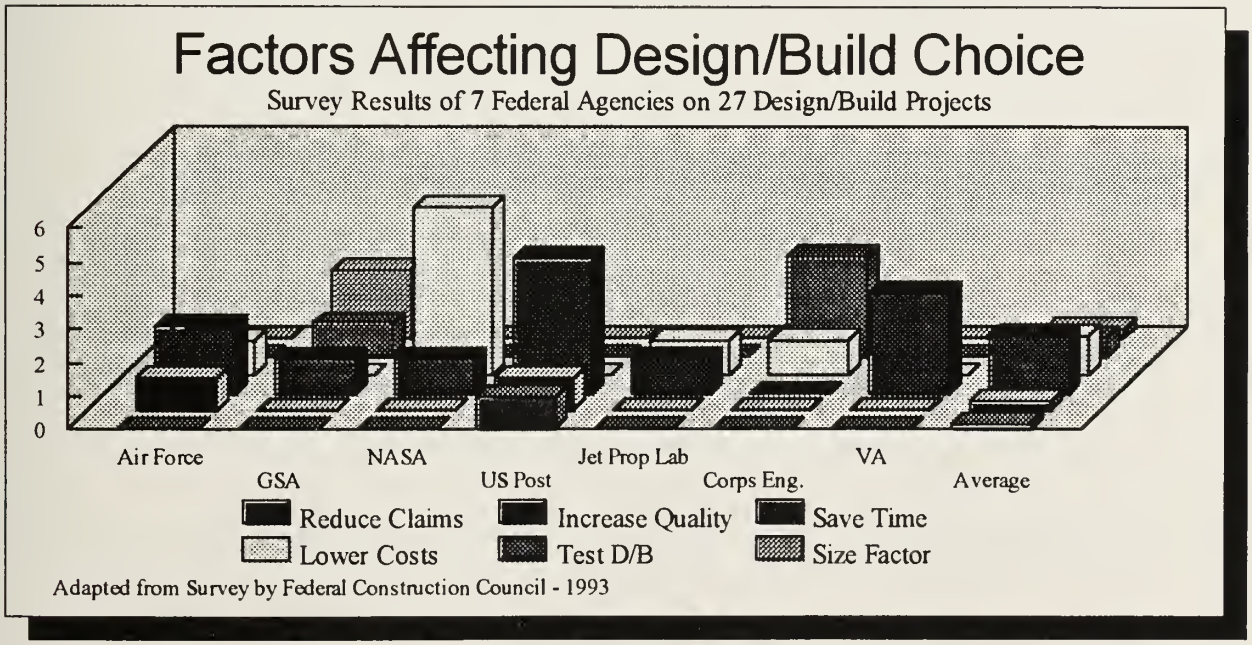

Figure 2.2 Factors Affecting Choice to Use Design/Build

The pie chart below provides a general indicator of what factors are taken into consideration by the federal agencies and how they are weighted on average:

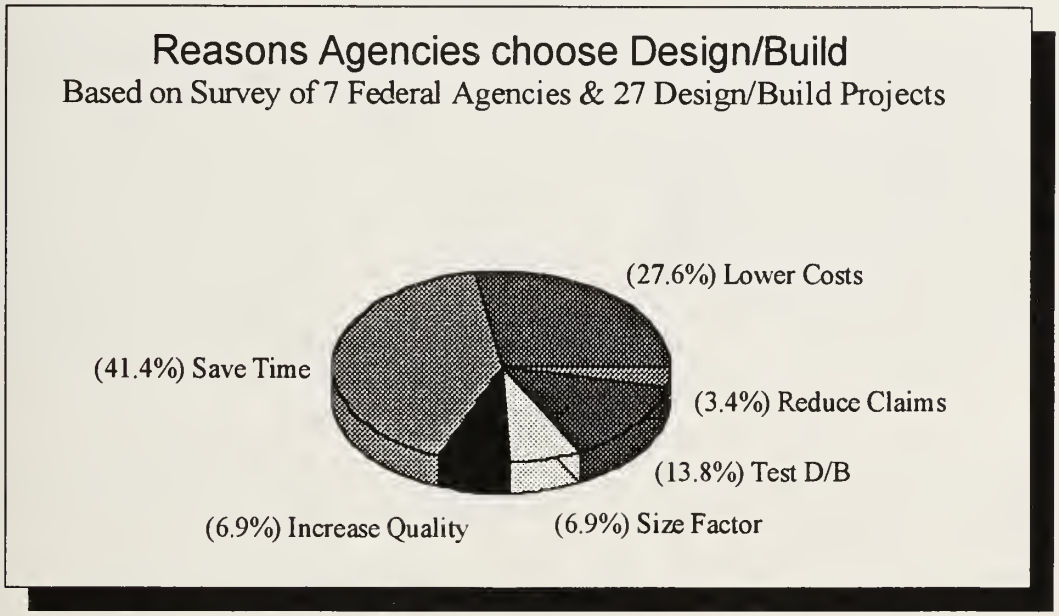

Figure 2.3 Reasons Federal Agencies Choose Design/Build

The results of the survey indicate that the two primary motivators were the expectation that the use of design/build would reduce overall procurement time (41.4%), and the belief that design/build would result in a reduction of overall costs (27.6%). Surprisingly, increasing quality and reducing claims were not very significant factors in the survey at 6.9% and 3.4% respectively.

The issue of whether these expectations were met in the final analysis was also investigated as part of the survey. Each of the seven federal agencies involved in the survey was asked to make a subjective analysis of the relative performance of the design/build contracts when compared to previous experience on comparable projects using conventional techniques.

The result of this survey is summarized in the chart below for the five major areas affected:

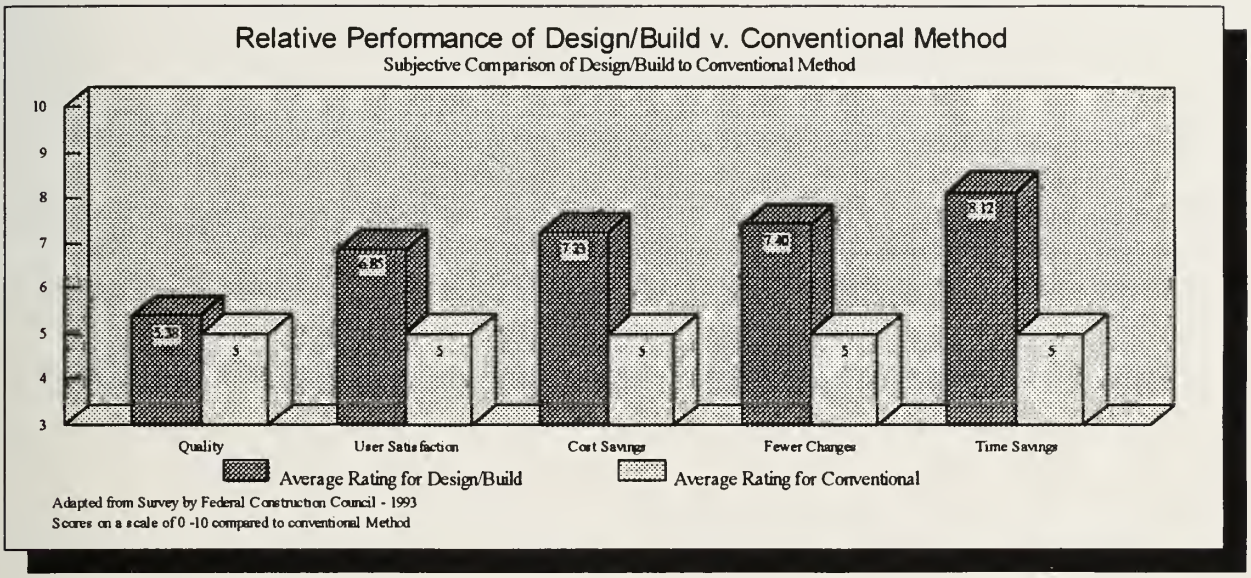

Figure 2.4 Survey Results Comparing Design/Build & Conventional

The survey results show that while quality was comparable or marginally improved, substantial improvements were noted in every other major category. The greatest improvement was time savings, averaging 8.12 on a scale of 0-10. The most unexpected result, with respect to the reasons given by the agencies for using design/build was the major improvement in change orders.

2.6 Navy's implementation of Design/Build Contracts for Facilities Procurement

As previously noted, during the period from 1972 until 1985, the services had no authorization to use design/build except for family housing. During the period from 1985 through 1991 the three project per year limit was in effect limiting each department's use of design/build techniques.

As a result of the aforementioned restrictions, the trend toward the use of design-build in the private sector has not been reflected until recently in federal agencies governed by the FAR. Accordingly, the Department of the Navy has proceeded with a fairly conservative use of this technique. "Congress authorized the Secretary of Defense to enter into up to three contracts per fiscal year for military construction ***on a turnkey basis through October 1, 1991."*** (Cushman/Taub 1992)

Federal statute 10 USC 2862 (a)(2) defines one-step turnkey procedur***es*** as those "used for the selection of a contractor on a basis of price and other evaluation criteria to perform, in accordance with the provisions of a firm fixed-price contract, both the design and construction of a facility using performance specifications supplied by the Secretary concerned." (Cushman/Taub 1992)

Due to these congressional mandates, the Navy has executed a very limited number of design-build projects which, with the exception of family housing projects, represented a minute fraction of their $1.75 billion annual contract volume. Family housing ranged from $173 million and 7.8% of the Navy construction program in FY 90 to $73 million in FY 92 representing only 4.2% of that years facility construction effort. The extent and focus of the non-housing design-build programs has thus far been so limited as to be considered primarily pilot programs.

During the period from 1985 - 91 the three project limit/year was in effect limiting each agency's use of design/build techniques. During this time the Navy executed several small projects each year using three variations on the design build method.

The Navy experimentation with these three different mechanisms to implement the design/build concept, has led to the following distinct categories or types of design/build: "Source Selection", "Two-step Sealed Bidding", and the "Newport design/build method". Figures 2.5 - 2.8, which are adapted from attachment 1 of "Newport Design/Build-May 1988, illustrate the differences between these three procurement methods, and contrast them with the traditional method.

Figure 2.5 below represents the traditional method.

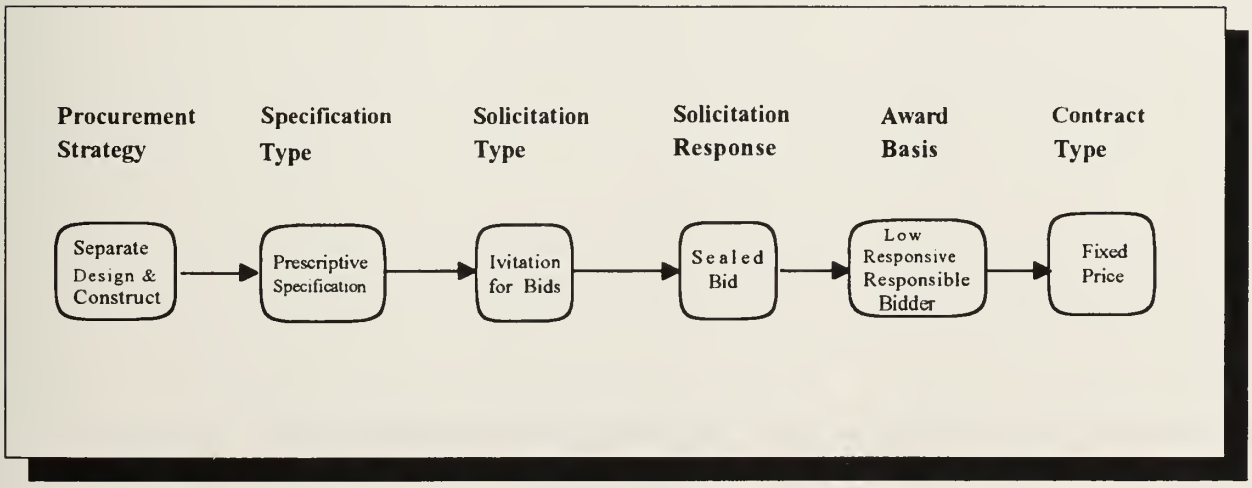

Figure 2.5 Traditional Procurement Process

The technique which is perhaps the closest to most common private sector forms of design/build, is referred to simply as "Source Selection". This entails selection of a contractor through "competitive negotiations". Both technical and price proposals are requested simultaneously, but are evaluated and ranked separately by two independent boards. After discussing the merits and deficiencies of each proposal, and perhaps deleting any undesirable or costly features, the proposers may be asked to provide "best and final offers".

An overall ranking formula is used to combine the results from both the technical and price committees. This method is also distinguished from the other two in that it allows award to be made to other than the low cost proposer with adequate justification. (Gunn 1992) Figure 2.6 below illustrates the **One-step or Source Selection method** of design/build. The heavy outlines indicate where the process differs from the traditional method:

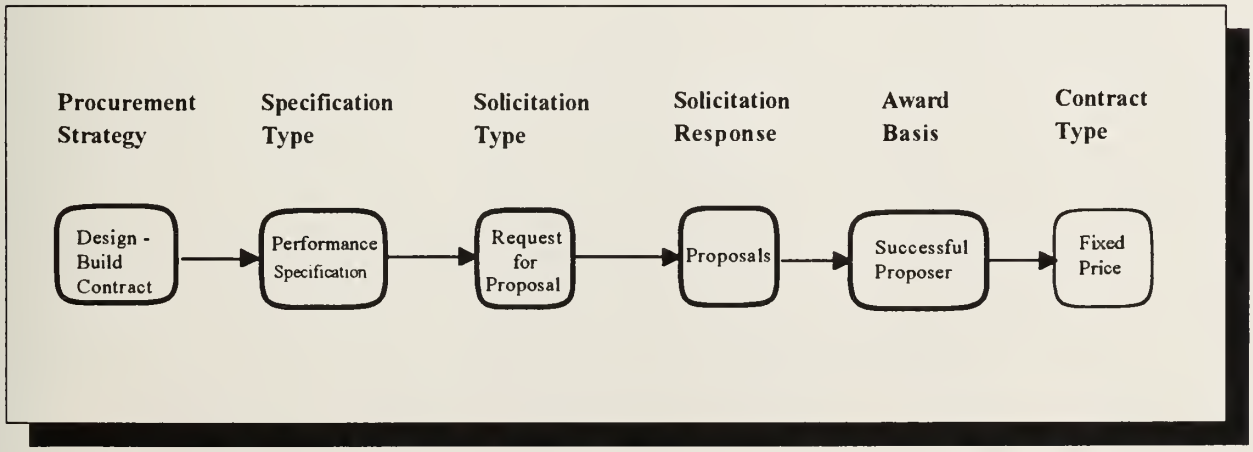

Figure 2.6 Source Selection Design/Build Procurement Process

A second design/build mechanism used by the Navy is the **Two-Step Sealed Bidding Method.** This method uses "competitive procedures....to obtain the benefits of sealed bidding when adequate detailed requirements are not available." (Courtillet 1992) It relies on a less detailed performance specification which gives more flexibility to the proposers to develop technical proposals, which are then evaluated for conformance to the stated performance criteria. A technical proposal is evaluated by a technical review board, for compliance with the RFP. Submissions which clearly do not meet the criteria established in the RFP are rejected, while those which have only minor problems may be given an opportunity to revise their proposals if they are conforming in most material respects. Those that meet the performance criteria are then given an opportunity to provide sealed bids for the project. The project is awarded to the low bidder. This technique cannot be used without prior approval from a Level 1 (Highest level) contracting officer.(Gunn 1992) Figure 2.7, below illustrates the distinct characteristics of the Two Step Design/Build method of design/build, with the items highlighted by heavy outlines indicating how and at what point the process differs from the traditional method.

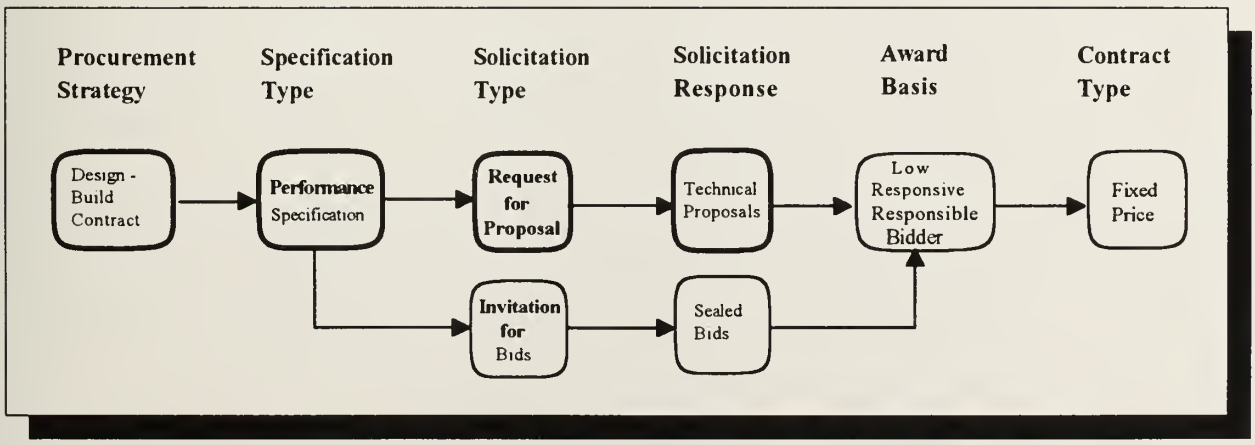

Figure 2.7 Two-Step Design/Build Procurement Process

A third technique, the **Newport design/build method**, is unique in that it combines the single source of responsibility concept with Lump Sum Competitive Bidding, awarding the contract to the lowest bidder. In this technique, the bidders do not have to produce technical proposals which can be quite expensive and risky for the proposer. Instead, the Navy provides a performance specification, which includes the fundamental design parameters which have been previously established by A/E or by an in-house effort. The successful bidder will then do the final "detailing" and the actual construction. If the design does not satisfy functional or aesthetic requirements, the contract has a close out option at the end of the design phase.

This method has the advantage of simplicity by avoiding the administrative cost and time required to evaluate technical and price proposals separately, or conduct extensive negotiations with each proposer. The quality of the performance specification is the key to success in this method.(Gunn 1992) Figure 2.8 below illustrates the distinct characteristics of the Newport Design/Build method, with highlighted items indicating where the process differs from the traditional method.

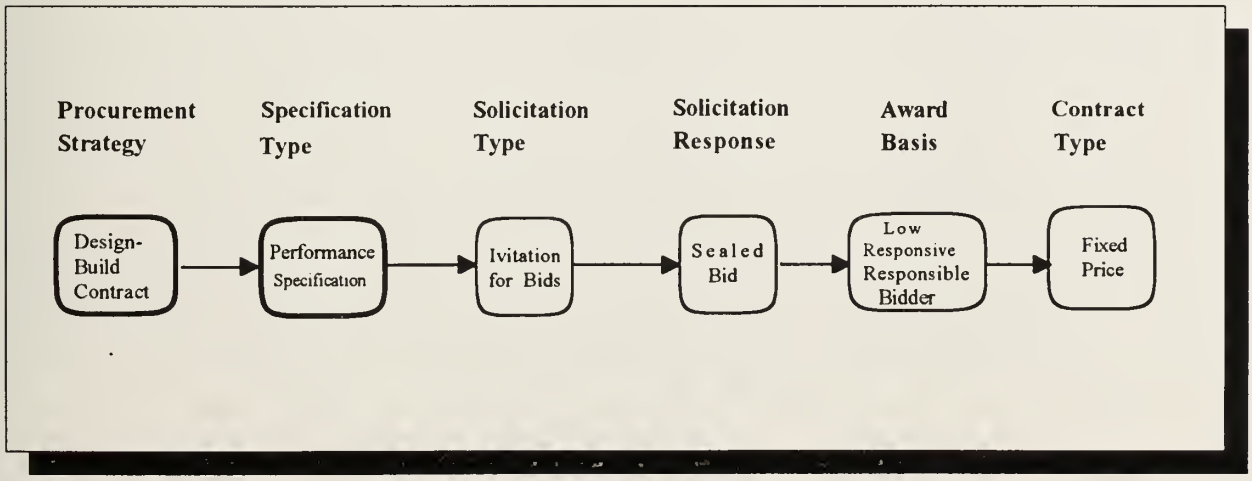

Figure 2.8 Newport Design/Build Procurement Process

The 3 project limit was lifted in FY 92. The Navy may now use Design/Build on an unlimited basis subject to Agency Head approval. The Navy plans to use the Newport Design/Build Method for $20.4 Million in FY 94 and $30.2 Million in FY 95. No source selection (except for family housing) or two-step design/build projects are currently slated for the next two fiscal years. Appendix A provides a complete summary of all non-housing design/build projects performed or scheduled to be performed by the Navy from FY 1985 to FY 1995, by fiscal year of execution.

The Navy's experience gained in the past few years utilizing these three design/build techniques, as well as their long history of executing family housing projects with design/build contracts puts them in an excellent position to evaluate the effectiveness of these techniques. This should allow the Navy to capitalize on the current opportunity to go beyond the traditional procedures and even help define some new options for other Federal Agencies in terms of adaptation of and utilization of design-build and certain variations as a viable tool for efficient contract execution.

If the Newport Design/Build method were to be used extensively in other Federal Agencies, perhaps many of the objections raised by A/E's about the high cost and uncompensated risk of proposals could be eliminated. In addition, the objections raised by contractors as articulated by the AGC regarding the unfairness of selecting other than low bidder might also be satisfactorily addressed.

Chapter 3 - Analysis of How the Navy can benefit from increased Design/Build

3.1 Fundamental Distinctions between Private Sector and Government Construction

To what extent can the benefits realized by the private sector be achieved in the NAVFAC facilities contracting system through greater utilization of design-build delivery? Certainly there are some significant differences between the goals and objectives of a private developer of malls or hotels, and the objectives of the US Navy in their various facilities procurement activities. Yet there are probably at least as many similarities as there are differences. The distinctions between the two approaches are more likely to result from the unique constraints under which Federal Agencies are required to act, and the level of accountability demanded by Congress. The most obvious difference between private and public projects is that the profit motive which drives the private sector's need for efficiency is replaced by government budgetary constraints and accountability of public officials to the congress and ultimately to the taxpaying public. However, the end result in either case should be an attempt to meet all the required programmatic requirements for the facility at the least possible cost. Thus the most relevant differences are primarily regulatory constraints and procedural guidelines which can be modified as appropriate.

3.2 A comparison of Pros & Cons of Design/Build for Private Sector v. Public Agencies

The advantages and disadvantages of Design-Build methodology as compared to conventional contract delivery were discussed at length in chapter 1, but to what extent are these benefits transferable to government contracting? Perhaps the most logical approach would be to compare point by point the various advantages and disadvantages which are said to accrue from the use of design/build in the private sector, and try to determine if they are relevant to public contracting.

Since the public is the ultimate beneficiary of any advantages derived by the utilization of design/build, their perspective will tend to be weighted toward that of the owner. Therefore, the advantages we are concerned with are primarily those that accrue to the owner (who in this case is the government), or those which indirectly benefit the owner by benefiting the design/build contractor. From this perspective we can evaluate the applicability of each of the following advantages which have reportedly been obtained through the use of the design/build strategy by those in the private sector:

1. Reduction in Total Project Delivery Time
2. Reduction in Total Project Cost
3. Single Source of Responsibility-Facilitates Administration and Coordination
4. More inventive design/construction solutions (due to A/E & Contractor cooperation)
5. Reduction in Project Management Stress
6. Reduced Incidence of Claims against the owner resulting from errors in plans & specs

1. Reduction in Total Project Delivery Time. At first glance, one might assume that this is less important to the government, since there is no profit motive, no construction loan, and no fear of rising interest rates. Quite to the contrary, in most federal agencies, the limited window of time during which a project must be executed can be absolutely critical to its existence. This is partly due to the political nature of the annual budgetary tug-of-war, and the requirement to execute appropriated funds for the purpose allocated within a given time frame, normally two to three years. These factors often mean that an agency ends up with funding for a project which must be

awarded (construction) within a very limited time frame during a given fiscal year. Often times, the critical path becomes preparing plans and specifications, advertising and awarding a project before the end of that fiscal year, after which the funds "expire", and cannot be used for the project. In addition, there are certain projects which are considered to be extremely high priority, either for operational reasons, or because of unforeseen circumstances such as natural disasters, a new Environmental Protection initiative or special congressional or agency requirements.

Furthermore, while federal agencies are not charged interest on the money that has been authorized for a given project awaiting construction, clearly the taxpayer is still paying interest due to the lost opportunity cost of capital and since a portion of the federal budget is in fact borrowed money. Thus to the extent that funds which are allocated for specific construction are utilized more expeditiously the taxpayer will not have to finance the outstanding dollars as long. This is a hidden efficiency, since there is no mechanism for tracking the increased cost of capital resulting from late delivery of a project, or from deficit spending. However, on a macro basis, we know that 21% of federal expenditures were funded by borrowing to cover the budget deficit, and that 14% of our total federal expenditures was devoted solely to pay the interest on that debt. (US Govt. tax booklet 1992)

2. Reduction in Total Project Cost. With the possible exception of execution time, this area is the one which will receive the most attention. Expected project cost savings will be the natural focal point of any serious discussion of the validity and viability of a different procurement technique being introduced into the federal government and NAVFAC. In view of the enormous

efforts to downsize each of the three services, and reduce federal spending on defense, it is likely that the "bottom line" by which virtually any program will be judged, is how much it can save in dollars and cents. This budgetary pressure is likely to continue into the foreseeable future, demanding the most efficient possible use of scarce construction resources.

Thus if it can be shown that design/build project delivery can in fact consistently produce measurable savings while providing facilities that meet the needs of the Navy ,without any adverse effect on quality, it should create a demand for broader implementation of this technique. The difficulty of this premise lies in the fact that establishing sufficient credible evidence to substantiate the alleged savings requires a substantial track record, which at this point is composed primarily of a few small "pilot projects" with limited variety of scope and fairly non-sophisticated programs, which were performed on the up side of the learning curve.

As a result there are two fundamental obstacles which work against the broader implementation of design/build in the Navy:

1) As a result of the relative infancy of the program, most projects performed to date have been performed while the contracting agency is still climbing the steepest part of the learning curve, which means that results will typically not look as favorable as they probably would in a fully mature program.

2) Since most of the early project have been fairly simple buildings, skeptics are likely to argue that there is no evidence that savings produced on relatively simple project could be extrapolated to larger and more complex projects.

3. Single Source of Responsibility-Facilitates Administration and Coordination. This point is seen by many developers and owners as perhaps the primary advantage of design/build. In the past this may not have been seen by government agencies or NAVFAC in particular as a very significant issue. However, with the downsizing of DOD agencies, the reduction in civilian staffing will continue to have a direct impact on the ability of these agencies to accomplish their facilities procurement activities. To the extent that having a single source of responsibility can reduce the administrative burden and decrease the actual workload required to accomplish a given amount of facilities construction, this should be a very welcome feature.

4. More efficient design/construction solutions (due to cooperation of Contractor & A/E). This point is one which would probably be hotly dispute by many A/E's, since the issue of quality design and ultimate project value are so subjective. However, this should not be seen as an affront to the A/E's integrity or ability. The premise on which this assumption rests is the unified nature of the design/build contractual arrangement. Typically in a design/build contract, the A/E is placed either directly or indirectly in the position of finding the most cost effective solutions in order to reduce ultimate costs in construction and maximize profits for the design/build firm or joint venture.

It is fairly obvious that the incentive to achieve a given budget figure is much stronger if you stand to gain by any savings achieved, or to loose the amount it goes over the budget. By the same token, the flexibility to make required adjustments along the way is also built into the system, making it possible to make mid course adjustments which would otherwise be awkward and

difficult. In addition the A/E has the additional input from the very outset from those who are most experienced in the actual construction phase. This creates an ideal atmosphere for the maximum integration of design and construction using constructibility principles which the Construction Industry Institute has defined as, "Optimum use of construction knowledge and experience in planning, design/engineering, procurement and field operations to achieve overall project objectives." This should result in more efficient design solutions, since the contractor and the A/E are literally on the same team right from the beginning.

In all three of the typical design/build arrangements utilized by the Navy these factors would still apply. Perhaps the only conceivable exception might be if the government sought to impose too many restrictions on the design process, or required the use of prescriptive rather than performance specifications in the contract. Therefore, if the design team is given the latitude normally associated with design/build contracts, and if the contractual arrangement provides either a guaranteed maximum price or some other form of incentive to keep costs in line, then the savings due to more cost effective design should be obtained as much in the public as in the private sector.

However, the surest test would be to examine actual performance results on contracts in private sector design/build contracts and compare the results with public design/build contracts. Such a study is beyond the scope of this paper, which only attempts to determine whether measurable savings can be obtained using design/build within the Navy contracting system as compared to the traditional Navy procurement methods.

5. Reduction in Project Management Stress. This is a very subjective matter, and one which cannot be resolved by resorting to contract performance statistics. The obvious improvement is that there is now only a single contract to administer, thus the effort required to award, manage and make payments should be commensurably reduced. Also to the extent that disputes between parties can be reduced through having a single point of contact, and certainly to the extent that claims and litigation are avoided, there should be a reduction in project management effort. This again should apply equally to private and public contracting.

It should be noted that of the three methods utilized by the Navy, not all are equal with respect to reduced administrative effort. The two-step procedure requires the most effort to administer, followed by source selection, and the Newport Method. Based on discussions with project managers who have utilized the Newport Method, it apparently requires approximately the same effort to administer as would be expected for a design contract of equivalent scope. This is a subjective analysis which is based on early experiences using the Newport method, thus the learning curve was undoubtedly a factor.

6. Reduced Incidence of Claims against the owner resulting from errors in plans & specifications. There appears to be no reason to expect a significant difference between public and private contracting in this area either. However, this point can only be validated statistically by comparing actual claim rates by contract. Unfortunately, this information was not available in the database accessed to prepare this paper. Thus an empirical response to this question must be deferred to subsequent research.

As earlier alluded to, in addition to the benefits there are certain risks as well. One of the major drawbacks is the loss of the traditional checks and balances provided by an independent party, normally the designer of record, reviewing the construction for conformance with plans and specifications. NAVFAC may experience some limited impact from the following three disadvantages to the owner which were discussed in chapter 2:

1. Loss of Design Professional as an Independent Professional Advisor.
2. Possible Reduction in Design Quality
3. Loss of Checks and Balances during construction (no independent oversight)

These effects would probably have less impact on NAVFAC than on a typical owner due to its unique infrastructure and in-house capabilities. For example, NAVFAC should experience almost no impact from the loss of independent oversight during construction, since they do not normally use the designer of record for construction observation services. This is done by in-house construction representatives. Likewise, the Navy is in a unique position as an owner with tremendous in-house engineering expertise which can compensate somewhat for the loss of an independent design professional.

While the research conducted for this paper does not include any survey of the contractor's perspective, there is no obvious reason to expect results to vary significantly from the factors experienced in the private sector. Thus it would be reasonable to assume that the contractor

would enjoy the following advantages through the use of design/build strategy whether public or private:

1. Increased control over the Project
2. Greater Job Satisfaction
3. Minimizing Risk and Project Uncertainty
4. Improved Communication with the Design Professional
5. Opportunity to Increase Profits (Shorter duration, more control)
6. Reduced Involvement in claims preparation and litigation.

By the same token the possible disadvantages to the contractor include the following points previously mentioned with the exception of number 2 which does not apply to NAVFAC:

1. Gaps in insurance coverage & increased insurance premiums
2. Increased risk of nonpayment (especially during design phase)
3. Assumption of Responsibility for the acts & omissions of the design professional
4. Loss of certain legal defenses

The risk of nonpayment during design phase for a design/build firm is essentially the same as the risk A/E's normally encounter doing design work for private clients - that if the project falls through for lack of funding or some other reason, the A/E may not get paid for his services. This is clearly not a risk that the A/E or the Design/Builder is expected to assume when performing

right to cancel the second phase, or construction port ion of the contract, yet the cost to the Design/build firm to perform the design will still be paid regardless.

3.3 Navy Facilities Procurement Mechanism: NAVFAC

Mission statement. NAVFAC's primary mission is to provide facilities engineering, construction, support for all Navy activities and certain other DOD and occasionally non-DOD agencies where NAVFAC is requested to provide assistance throughout the world.

NAVFAC's Organizational Structure. NAVFAC has headquarters in Alexandria, VA, with 7 major Engineering Field Divisions as follows: Chesapeake Division in Washington, DC, Northern Division in Lester, PA, Southern Division in Charleston, SC, Atlantic Division in Norfolk VA, Western Division in San Bruno CA, Soutwest Division in San Diego, CA and Pacific Division at Pearl Harbor, HA. See appendix E for map of geographic areas of responsibility. These seven organizations range in size from 600-1400 civilian employees each. Each Engineering Field Division also has a number of subsidiary field activities reporting to it. These are referred to as Engineering Field Activities, Officers in Charge of Construction, or Resident Officers in Charge of Construction depending on their size, responsibility, and level of authority.

Facilities Acquisition Process. The typical project begins when the local activity identifies the requirements and prepares a 1391 which is a document defining the basic programmatic requirements and a parametric cost estimate based on square footage and preliminary assessment of type construction. This document is then submitted up the chain for approval by the resource

sponsor, and eventually by congress. Once a project is approved by congress, it is considered to be programmed for a specific Fiscal Year of construction. After funding is appropriated for the project, the resource sponsor sends design authorization to the Engineering Field Division in its region, signaling its intent to proceed with the project. It is at this point that the NAVFAC organization can begin the actual engineering/design and contract work to prepare the project for construction.

While a few projects are designed by in-house engineering staff each year, most projects of any magnitude are designed by A/E's under contract to NAVFAC. This process is handled by a project manager who is assigned responsibility for overseeing the process of slating and selecting an A/E and managing the contract until completion of acceptable contract documents. The completed package is then turned over to the Contract Department for solicitation, bidding, and award of construction.

Method of Construction Execution and Management. After the construction contract is awarded, which is normally to the low bidder, the Resident Officer in Charge of Construction is given responsibility to administer the contract for construction. Specific responsibility for a given contract is then normally assigned to a Civil Engineer Corps Officer who generally has a team of civil service employees consisting of an engineer, an inspector, and pooled sectretarial, clerical and contracts support. For a very large or complex project, it is possible that there would be additional contracted support in terms of field inspectors, safety specialist, scheduling experts, etc. The lead time for this entire process from project inception to completion is quite long when

compared to private enterprise. Generally speaking the cycle must be started at least 5-6 years before expected completion. This becomes very troublesome when viewed in light of the rapid changes which have been occurring in the military establishment in recent years. When base closures and realignment decisions occur, it forces some projects to be abandoned, and others to be expedited or initiated on a fast-track.

3.4 Specific Application of Design/Build to Navy Contracting

One major difference between private sector and government contracting is the unique requirement to execute (use or loose) funds prior to the end of the Fiscal Year each 30th of September. In the case of the Navy, this translates into a frenzied effort to execute many projects before the end of September, which can be a real challenge for those which were introduced late in the cycle or have suddenly been given a green light by their major claimants (funding agency).

Furthermore, it is apparent that the trend toward shrinking budgets does not have an end in sight. Accordingly, the increasing demand for more effective use of scarce dollars will probably continue into the foreseeable future. Facilities delivery techniques which can offer significant savings over traditional methods without sacrificing quality will become more popular.

Likewise, reduced staffing which has been the trend during recent years, will force the most efficient use of personnel resources. The maxims of doing more with less and working smarter *and* harder, has already become clichés in the NAVFAC community. Thus as these pressures continue, and the remaining personnel are expected to accomplish as much or more than before,

additional tools will be needed to streamline the process and enhance their productivity. Cutting the number of contracts requiring administrative effort in half by issuing a single contract for both design and construction is certainly a step in the right direction.

Based on four projects which were done using the Newport Design/Build method to construct child development centers, there are clear advantages in time and overall cost reduction The cost savings ranged from 21% to 26% based on the variation between the low bid received for the four design/build projects, and the government estimates, which were based on similar projects done in that area. The most remarkable improvement however, was in the project schedule. The typical schedule for a project of this scope would be approximately 60 months from NAVFAC authorization to completion of construction. The average execution time using the "Newport design-build" method was 29 months, less than half the time required using the traditional contracting procedures.

The only drawback observed during this process was a slight increase in the overhead costs associated with the preparation and administration of the contract from NAVFAC's perspective. While the conventional A/E design procedures require 7.2 % of the estimated construction cost (ECC) to administer, design-build contracts demand 7.7 % of ECC. This is a marginal increase of half a percent of ECC, or a 7% increase in administrative costs. This may reflect the greater level of intensity due to the increased pace of project execution, and the higher level of coordination demanded as a result. It may also indicate that the process is still on the upward slope of the learning curve, and should improve as the procedures become more common and routine.

Based on the six child care center cases documented to date there appears to be conclusive evidence validating the theoretical advantages of design/build. It would be expected that with the integration of the design and construction responsibility, there would be a measurable reduction in the number and magnitude of change orders. It is reasonable to expect for example the virtual elimination of contractor requested changes resulting from errors and omissions in the specifications, and the litigation that sometime follows failure to resolve these issues in a timely manner.

Clearly, change orders cannot be totally eliminated, since some originate due to owner requested changes, owner imposed delays, failure to provide timely reviews approvals, or government furnished equipment or materials, interference by other contractors, or subsurface conditions, etc. None of these factors are influenced by the type of delivery chosen, and could not be expected to be improved by use of design/build strategies.

However, many of the most contentious and costly sources of disputes could be eliminated by virtue of the fact that the design builder would be responsible for all phases of the project and could be held more accountable for any problems. This would be especially useful in instances when, as so often happens, it is not absolutely clear whether a problem is in fact a design or a construction error, or maybe a combination of the two. Often valuable time and resources are wasted just trying to address the issue of who is to blame, which adds no value to the project. For the above mentioned reasons, it is argued that design-build can offer significant advantages to the Navy over the traditional method of awarding separate A/E and construction contracts.

Chapter 4 - Analysis of Performance: Design/Build vs. Traditional Method

4.1 Source & scope of data used for the Analysis.

The purpose of this analysis was to determine if existing empirical data on both conventional and design/build construction contracts executed by NAVFAC could be utilized to provide an unbiased context for examination of the effects of delivery techniques on performance. Specifically, the objective was to find at least two, and preferably several comparable projects performed at about the same time frame with the primary difference being the use of design/build as opposed to the conventional design/bid/build contracting strategy.

Only projects which had been completed and closed out were to be included in the study since this would preclude premature conclusions as to final cost and change order rates. All of the projects compared were to be awarded the same year thus minimizing any impact that inflation might have had on the results. The geographic index factors which might otherwise cause variations in the results due to regional differences are built into the original cost estimate which is site specific. Thus regional adjustments were already accounted for by the cost estimators who are most familiar with the region they are responsible for.

In addition, no projects prior to 1985 were included in this data set since no serious attempts to utilize design/build were undertaken prior to that time with the exception of the Family Housing programs. However, since Family Housing has been done almost exclusively using a form of design/build for the past two decades, there was little opportunity for accurate control data based on similar projects executed by the Navy using conventional methods. Thus, no family housing projects were included for this research, although this would be appropriate to study if sufficient control projects could be identified for comparison.

4.2 Methodology used to Select Specific Projects Utilized for Analysis.

The number of like projects considered might have been quite limited had it not been for a very fortunate turn of events; as a result of the changing complexion of the military service, with an increasing percentage of women, and single parents, congress had programmed 11 child care centers to be constructed during FY 90. Even more fortuitously, 5 were procured using conventional design/bid/build procurement methods, while the remaining 6 were executed using two distinct types of design/build techniques.

Based on the above described criteria for project selection, these eleven child care center projects which were awarded in 1990 were chosen for the study. Of the eleven, two were procured using the one-step source selection design/build process, four were procured using the "Newport design/build method", and five others were procured using the conventional procurement method. With the assistance of personnel at NAVFAC headquarters, data was obtained on these projects from NAVFAC's Construction Management Information System (CMIS) which tracks critical project execution statistics for all NAVFAC construction projects exceeding $500,000. Thus, this became the lower dollar threshold for projects in this research. There was no upper limit constraining project value. Appendix B contains the resulting project data for these eleven child care centers, listed by method of procurement.

4.3 Methodology used to estimate average savings.

In order to minimize the effect of potential differences in size, square footage, or other variations between individual projects, a single common factor was selected to use as the basis for initial comparisons of project scope and value. This figure is the programmed amount which is based on the initial parametric cost estimate determined by professional cost estimators for the square footage, scope, building type, regional material and labor costs and other specific factors. This programmed amount was determined before the procurement method was chosen, effectively eliminating any possibility that the estimate would reflect predispositions, biases or expectations of savings or costs associated with a given procurement method.

Savings were then calculated using a simple ratio of actual costs over programmed amount. The actual costs included in-house administrative effort, design contract cost, construction contract award amount plus all subsequent change orders. The calculations for determining actual savings for each method are made as follows: The sum of all actual costs for a given procurement procedure is divided by the sum of the programmed amount for all such projects. This can be described mathematically in fairly simple terms using the following variables:

ACG_C Average Cost Growth (ACG) for Conventional Method

I_C In-house Administrative & design Costs (for Conventional Method)

D_C Design Contract Cost (for Conventional Method)

C_C Construction Contract Award Cost (for Conventional Method)

M_C Modifications & Change Orders Costs (for Conventional Method)

P_C Programmed Amount (for Conventional Method)

The formula for finding the Average Cost Growth for the Conventional Method would be:

$$ACG_C = \{\Sigma(I_C + D_C + C_C + M_C) \div \Sigma(P_C)\} - 1$$

Likewise, the formula for the Average Cost Growth for the One-Step Design/Build Method is:

$$ACG_O = \{\Sigma(I_O + D_O + C_O + M_O) \div \Sigma(P_C)\} - 1$$

Finally, the formula for the Average Cost Growth for Newport Design/Build Method is:

$$ACG_N = \{\Sigma(I_N + D_N + C_N + M_N) \div \Sigma(P_N)\} - 1$$

These ratios have been calculated for each of the three procurement methods as indicated above, and the results are shown below in Tables 4.1 - 4.3, as well as the location, programmed amount, in-house and contracted design costs, construction contract award amount, and total cost for each project. The Average Cost Growth (ACG) for each category is shown in percentage form in the lower right hand corner of each table. All other amounts are in thousands of dollars.

FY 1990 Child Care Centers Using Conventional Design/Bid/Build Procurement Method

ACTIVITY	Prgm Amt	A/E Awd	In-House	Constr Award	C/O Mod	($000) Total	% Incr of PA
San Diego CA	1,000	407	43	970	36	1,465	46.5%
Beaufort, SC	970	85	14	924	391	1,414	45.8%
Monterey CA	2,000	277	51	1,905	275	2,508	46.1%
Great Lakes, IL	2,300	407	107	2,190	(1)	2,703	17.5%
San Diego CA	2,350	239	406	2,085	208	2,938	25.0%
Averages	1,724	283	124	1,617	182	2,206	**27.9%**

Table 4.1 Conventional "Design/Bid/Build" Child Care Centers

FY 1990 Child Care Centers Using "One-Step Source Selection" Design/Build Method

ACTIVITY	Prgm Amt	A/E Awd	In-House	Constr Award	C/O Mod	($000) Total	% Incr of PA
Bremerton WA	1,000	18	63	988	18	1,087	8.7%
Fallon NV	1,000	11	71	1,074	4	1,160	16.0%
Averages	1,000	15	67	1,031	11	1,124	**12.4%**

Table 4.2 "One-Step" Design/Build Method Child Care Centers

FY 1990 Child Care Centers Using "Newport Design/Build Method" of Procurement

ACTIVITY	Prgm Amt	A/E Awd	In-House	Constr Award	C/O Mod	($000) Total	% Incr of PA
Brunswick ME	1,000	1	77	794	77	949	-5.1%
New London, CT	1,000	41	79	838	121	1,079	7.9%
Kittery ME	1,000	1	103	782	157	1,043	1.4%
Dahlgren VA	1,000	79	49	1,043	1	1,172	17.2%
Averages	1,000	31	77	864	89	1,061	**6.1%**

Table 4.3 "Newport Design/Build" Child Care Centers

4.4 Estimated Average Cost Reductions by Type of Design/Build Method Used.

The Average Cost Growth (ACG) percentage for each respective procurement method would not be particularly meaningful considered alone, because the programmed amount does not include any estimated cost for design award or in-house administration of the design contract. The primary significance of these figures is that they provide a very useful barometer of cost performance for each procurement procedure relative to a standardized base figure which is common to all projects. The ACG for the conventional method can be used as the basis for measuring savings, since it currently represents the vast majority (97%) of facilities procurement in the NAVFAC system, and thus becomes the de facto standard of performance. Thus, the difference between the ACG for the conventional method and the ACG for the design/build method under consideration is the net savings for that design/build type. Savings for the Newport Method are as follows: $S_N = ACG_C - ACG_N$. For One-Step, it would be: $S_O = ACG_C - ACG_O$.

Based on Tables 4.1- 4.3 on the preceding page, it is immediately evident that the cost of procurement using the conventional method is considerably more than either of the two design/build methods. Using the above described formulas for relative savings, the one-step method is saving 15.5%, (27.9% - 12.4%) over what would normally have been paid using conventional procurement. Similarly, the Newport method is saving 21.9% of the amount which would otherwise have been spent using conventional methods (27.9% - 6.1%).

Tables 4.4 and 4.5 provide some interesting insights into the source of these savings by allowing direct comparison of the relative contribution of the various component costs associated with facility acquisition. The Average figures from Table 4.1 have been divided by 1.724, the ratio between the average programmed amount for conventional and design/build projects in the study. This facilitate direct comparison between conventional & design/build cost breakdowns, as shown in Tables 4.4 and 4.5 on the following page.

Factors Affecting Savings from "One-Step Source Selection" Design Build Method							
Procurement Method	Prgm Amt	A/E Awd	In-House	Constr Award	C/O Mod	($000) Total	% Incr of PA
Conventional	1,000	164	72	938	105	1,279	27.9%
One-Step D/B	1,000	15	67	1,031	11	1,124	12.4%
Difference	0	150	5	(93)	94	156	**15.5%**
% of Savings		**96%**	**3%**	**-60%**	**61%**	100%	

Table 4.4 Factors Affecting Savings for "One-Step" Method

Factors Affecting Savings from "Newport Design/Build Method" of Procurement							
Procurement Method	Prgm Amt	A/E Awd	In-House	Constr Award	C/O Mod	($000) Total	% Incr of PA
Conventional	1,000	164	72	938	105	1,279	27.9%
Newport D/B	1,000	31	77	864	89	1,061	6.1%
Difference	0	134	(5)	73	16	219	**21.9%**
% of Savings		**61%**	**-2%**	**34%**	**8%**	100%	

Table 4.5 Factors Affecting Savings for "Newport Design/Build"

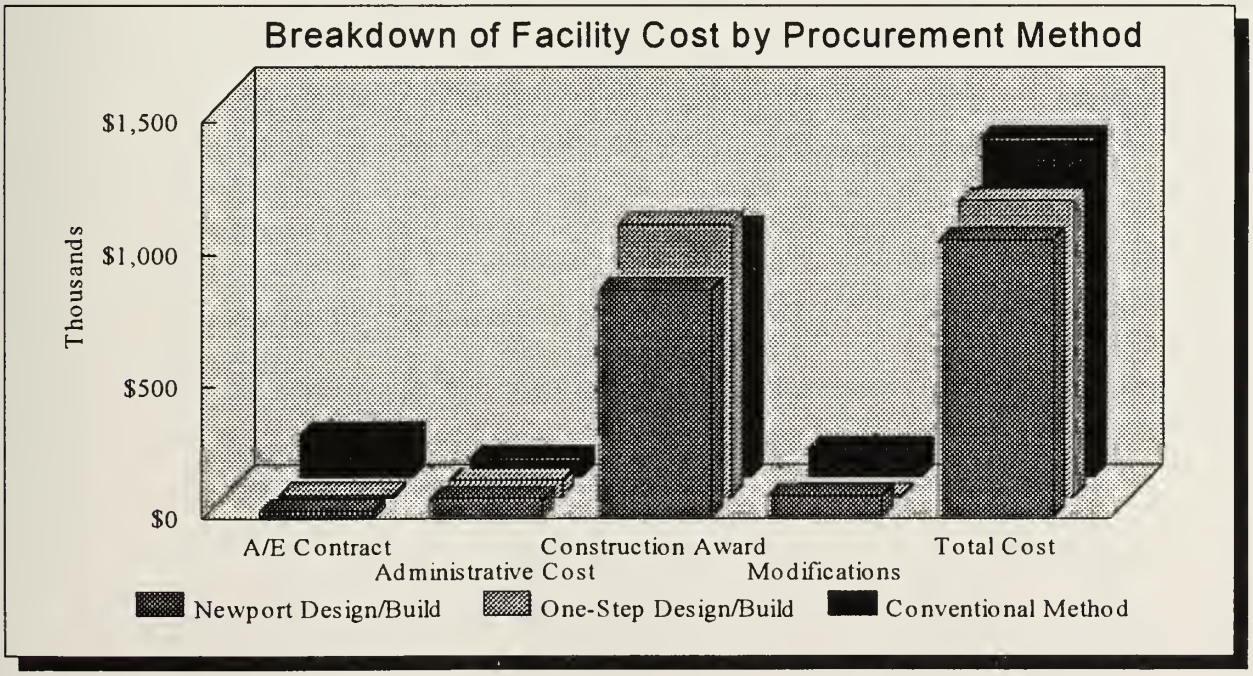

Figure 4.1 Facility Cost by Procurement Method

Table 4.4 shows the sources of the savings from the one-step source selection design/build method. Interestingly, the significant reduction in change orders during construction which would result in savings of 9.4% are almost exactly offset by the 9.3% premium on the original contract price at award. In fact, this analysis shows that savings from the one-step method are achieved almost exclusively through lower design costs. It should be noted at this point, however, that the design cost shown here do not include what the contractor paid for his portion of the design, since this cost was buried in the construction contract award. Therefore, it would be incorrect to conclude that the bulk of the savings came out of design. It is true that NAVFAC's direct design costs were less, since the remaining design costs were picked up by the contractor. Yet, the overall cost was still 15.5% lower than it would have been using conventional techniques.

Table 4.5 provides a very different distribution of savings, with perhaps the only similarity being that the majority, though not all of the savings came from a reduction in NAVFAC's design costs. 34% of the savings came from significantly lower construction contract award and a reduction in change orders, which accounted for another 8% of the total savings. The most startling fact is that these combined savings result in a reduction of almost 22% from what it would have cost under conventional design/bid/build methods. This figure does not take into account the value of early completion, but is strictly based on actual dollar savings, without regard to completion date.

Figure 4.1 provides an overall perspective by summarizing the various costs associated with each procurement method and comparing them to the conventional method. All three methods vary by

only a few percent with respect to administrative overhead for contract management . The most striking difference is the tradeoff between upfront award costs, and change orders during construction with the one-step method, and the significant overall Newport Method savings.

It should be noted that three of the five control projects using conventional procurement had a programmed amount of $ 2 million or more, while the other two were nearly identical in scope at around a million dollars each. However, this does not seem to have adversely impacted the overall percentages for the conventional method. In fact, the average cost growth for the larger projects was considerably less than the average cost growth for the two smaller ones.

This raises the possibility that including the projects of larger scope may have skewed the resulting calculation for relative savings of design/build downward. However, by increasing the number of control projects, the average for the conventional method should be less susceptible to the possible influence of isolated geographic, job specific factors, or other unknowns. It is fair to say that using this approach would normally be expected to generate, as it does in this case, a more conservative estimate of possible savings from the techniques being studied.

4.5 Methodology used to estimate average time savings.

Although proponents of the Newport Design/Build method claim that it can reduce project delivery time by as much as 50%, this was not possible to validate statistically with the information available in the CMIS data base. The problem was that the CMIS data only contains information on the execution of the construction contract and does not include any information on

the date of design authorization, date of award of design contract, or date of completion of design. As a result, the only information available on time was award of construction contract and completion of construction. Therefore, if design/build contracts were compared with similar conventional contracts, the results would be misleading since each design/build method includes in the allotted contract time a design phase and a period for government review and approval. The conventional method requires time for the slating and selection of an A/E to do the design, then, negotiations with the A/E on scope and amount of contract. Then the negotiations as well as the results and justification of the slate and selection boards must be written into formal audit proof documents. Finally the recommendation for award is given to the contracts department which is responsible for the actual award. This entire process generally takes at least 9 months.

The next step is the actual execution of the design phase which typically takes 6 - 9 months for an average project. This includes government reviews at the 35% and 90% completion stages. Thus, even for a relatively simple project, the total process required to prepare a complete Invitation for Bid Package (IFB) from inception to bid ready documents is a minimum of 15 months, and probably 18 or more months would be more typical.

The Newport Design/Build method by contrast compresses the first part of this process, since no slating, selecting, negotiating or board reports are required if the construction contract includes the requirement to provide the A/E and execute the design as part of the design/build contract. There is clearly a certain level of effort required to put together the IFB package in a unique

performance specification format, and to produce a schematic floor plan, and complete site drawings as called for in the Newport method. However, those who have participated in this process have stated that the manpower and workload is roughly equivalent to that required to manage a comparable A/E contract.

We can estimate the amount of time used in preparing schematics and performance specifications for the Newport method as approximately 6 months, which is 3 months longer than required for a scope of work for the A/E constract. Using this basis we can say that the typical time difference between Newport and conventional is in the range of 12 - 15 months. In comparing the execution times, the most conservative possible position was taken, and 12 months was added to conventional times to compensate for the fact that the conventional contracts do not include any time for slate, select, negotiate, award by the Engineering Field Division and design by the A/E.

4.6 Estimated Average Reduction in Project Execution Time.

The computation of average reduction in project execution time is made by simply adding six months to the projects using conventional methods to approximate the additional time required to slate, select award and design the project, then subtracting the total design/build time from the resulting conventional time. The average result achieved using this technique is as follows:

Newport method: 8.3 months savings in project execution time.

Source Selection: 10.5 months savings in project execution time.

2-Step Method: Not enough information

In order to make a more accurate assessment of the amount of time saved using design/build, it would be necessary to access project manager and contract files for each of the individual projects in the study, compile the results and use actual times rather than conservative estimates. It is likely that a survey of actual time saved would be far greater than the estimate using this method.

4.7 Analysis of Differences in Change Order Rates.

Change order rates are ordinarily computed as a percentage of the construction award, rather than as a percentage of the programmed amount. The problem with using the standard method for a statistical study of different procurement techniques is that for methods which encourage a contractor to bid low and make it up on changes, the change order rate will be artificially high because it is based on a denominator which is artificially low with respect to actual project scope and final cost. However, to allow a more intuitive frame of reference and to provide a more conservative estimate of the impact of design/build on change order rates, the standard method will be used as well as the holistic project approach which uses the programmed amount as the point of reference for each project. This will also allow validation of the programmed amount approach.

Taking the approach based on programmed amount first, it can be observed from Table 4.4 that the reduction in the change order rate for the one-step method was quite dramatic, dropping from 105 per 1000 or 10.5% for conventional methods to 11 per thousand or 1.1% for the one-step design/build method. The Newport design/build method did not cause such a dramatic reduction,

but did have some effect by bringing the 10.5% rate down to 89 per 1000 or 8.9% of programmed amount. Although this is only a modest 15% decrease, it should be observed that this represents not only the change orders in the construction phase, but those which occurred during the design phase also.

Due to the method of contract administration and financial record keeping which treated design and construction changes alike under a single contract, it was not possible to segregate design and construction changes for the entire data set. However, in March of 1992, during a presentation given by NAVFAC on their experience with Newport Design/Build, it was reported that the change order rate on the Brunswick Child Care Center was 6.7% of the award amount, of which 1.9% was due to design changes required as a result of missing design criteria in the original solicitation package.

If we assume that this ratio of design to construction changes is fairly typical then we can derive a simple index factor which would allow a more relevant correlation between the change order rates for design/build contracts and those for the conventional methods which only include construction changes. Using the actual dollar costs cited in this report to avoid rounding error, the ratio is derived by dividing all construction changes by the total cost of all change orders: $34,819/$48,926 = .7117%. Thus approximately 71% of changes were construction related, while the balance were design changes due to missing design criteria in the original Invitation for Bids (IFB).

Taking this index factor into account for the Newport Design/Build average change order rate, we would have 8.9% x .7117 = 5.09%, which is just under half of the conventional 10.5% change order rate experienced building child care centers. Since the one-step source selection method of design/build yields such an extraordinarily low change order rate of only 1.1%, it hardly seems worth belaboring the issue of whether the Newport index factor should be applied to the one-step process as well.

Using the conventional method for calculating change order rates, i.e. by dividing the average amount of cost growth due to changes by the initial award amount we obtain the following results:

Conventional Method:	$105,000 / $938,000 = 11.19 %
Newport method:	$89,000 / $864,000 = 10.31 % x .7117 = 7.33 %
Source Selection:	$11,000 / $1,031,000 = 1.07 %
2-Step Method:	Not enough information

With this method, the reduction in change orders is not as striking, but still significant. If 11.19% is used as the benchmark, then the 7.33% average achieved by the Newport method constitutes a 33% reduction in change orders in the field. The one-step method is even better at only 1.07% for a remarkable 90% reduction in changes! Suffice it to say that both methods can be expected to significantly reduce field changes, thus minimizing delays, added cost, administrative burden,

and possible litigation from claims. These findings are summarized in Figure 4.6 below, which shows the average change order rates for each of the two design/build methods compared to the conventional method. Results are shown using both the contract award and the programmed amount as the basis for determining percent of cost growth.

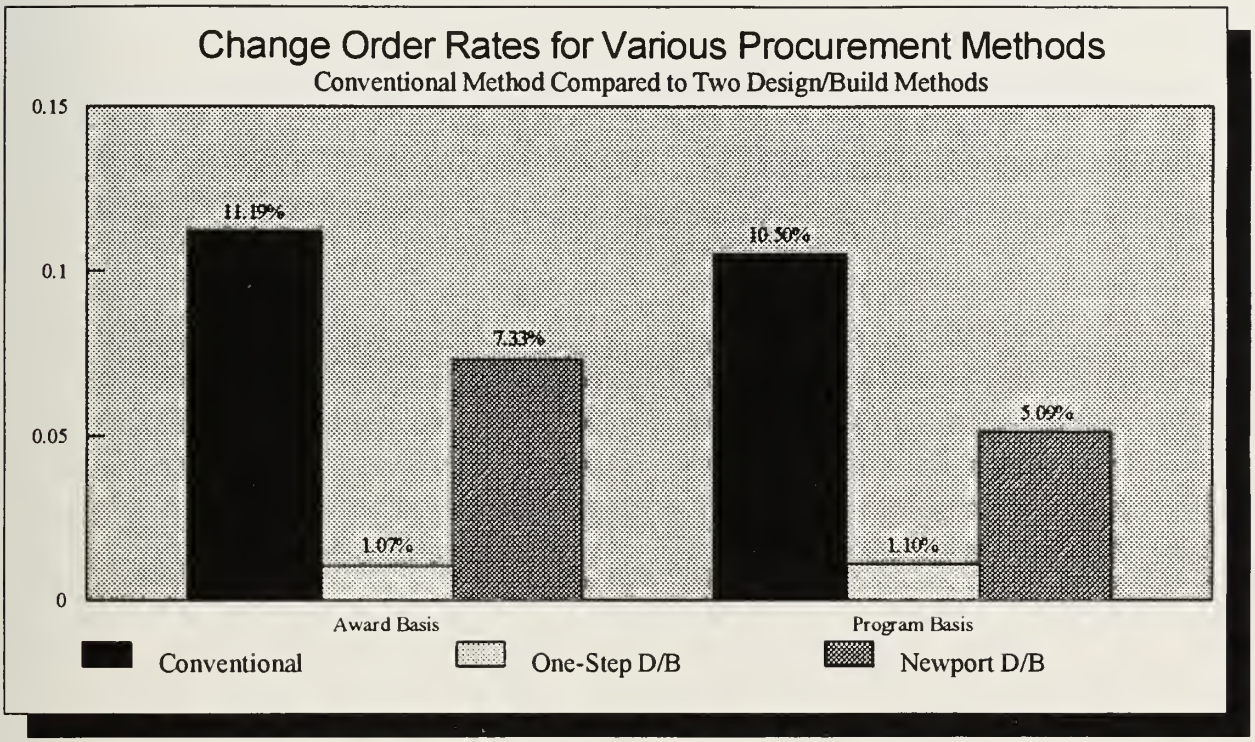

Figure 4.2 Change Order Rates by Procurement Method

It is also interesting to note that one possible explanation for the marked difference between the two design/build methods may be that with the Newport Design/Build method, the Navy provides a complete set of site drawings, which for the civil and site work places the Navy in the same position as if it were using a conventional contract. This point is very clearly illustrated in Table 5.1, which reveals a disproportionate level of site/civil/utility changes in the change order history of the Newport Design/Build case study presented in the next chapter.

Chapter 5 - Case Study of a Newport Design Build Project at Brunswick, ME

5.1 Description of Project

The project selected for this case study is a child development center located at Naval Air Station, Brunswick, Maine. It was programmed at a minimum of 6,496 square feet with an estimated cost of $1 million. It was expected to be awarded in FY 1990 and completed within 360 days of award, including design and construction. It was only the second such project attempted by this Engineering Field Division using Newport Design/Build.

5.2 Newport Design/Build Process

The Newport design/build method is a unique hybrid facility procurement method which combines the advantages of the single source of responsibility concept with the advantages of Lump Sum Competitive Bidding. The bidders do not have to produce technical proposals which can be quite expensive and risky for the proposer. This avoids the ethical and public relations dilemma of whether to pay each proposer a stipend or honoraria for the cost of the proposal. Using in-house engineering personnel, or an A/E contract, the Navy prepares schematic drawings and performance specifications which are used as the basis for a competitive bidding process.

The award is based solely on price, and is made to the lowest responsive, responsible bidder who will then complete the design, and after approval of the completed design, proceed with construction of the facility. The contractor is given 3-4 months to complete the design, depending on the size. If after the 100% submittal date, the design does not satisfy functional or aesthetic

requirements contained in the IFB, the Navy may request that the contractor modify the proposed design at no additional cost to the Navy to bring it into compliance. If after a specified period (usually six months) the contractor is unable or unwilling to resolve the discrepancies to the satisfaction of the Navy, the contract has a 2.5 % close-out option at the end of the design phase. This method has the added advantage of simplicity for the Navy because it avoids the administrative cost and time required to evaluate technical and price proposals separately, or conduct extensive negotiations with each proposer.

5.3 Development of Invitation for Bid (IFB) Package

The greatest challenge for those preparing an IFB package on a design/build project is walking the fine line between providing sufficient detail to ensure the customer will get what he needs, without constraining the contractor to the point that he looses the flexibility inherent in the design/build process. This is especially difficult for those who have considerable experience with the traditional method, and don't have confidence in a non-prescriptive performance type specification. The IFB package contained the following documents:

1. A schematic floor plan
2. A partial door schedule
3. A complete finish and color schedule
4. 100% complete site drawings
5. Soil Boring Logs
6. Performance Specifications for major building systems:

    Structural System

Roof System

Exterior Wall System

Floor System

Doors and Windows

Interior Partition System

Carpentry and Millwork

Plumbing

HVAC

Exterior Power, Lighting & Communications System

Interior Power, Lighting & Communications System

7. Prescriptive Specifications for site work, and special building items

All Exterior & Site Work

All Finishes

Signs

Fire Extinguishers & Cabinets

Toilet & Bath Accessories

Electric Kitchen Equipment

Venetian Blinds

Mechanical General Requirements

Insulation of Mechanical Systems

Testing and Balancing

Fire Alarm & Fire Detecting System

The cost of preparing this IFB package using in-house staff only was approximately 9.5% of the estimated construction value. This consisted of 1.7% administration and 7.5% actual preparation of the IFB package. This compares to 2% and 5% respectively, for a total of 7% for a typical A/E design. However, it was observed that this was due to the fact that there was a steep learning curve with this new procurement method, there were no existing guide specs in the performance specification format, and there were new design team members. (Briggs-1992)

Prior to the release of the IFB package for advertisement and competitive bidding, there is a simultaneous 100% review by Major Claimant (resource sponsor), end user, Public Works Department, and in-house professional engineering staff. (Briggs-1992)

5.4 Program Manager's Perspective

The project manager for the design phase was Mr. James M. Briggs, who works as a design manager in the Quality and Cost Branch at Northern Division, Naval Facilities Engineering Command (Northdiv), located in Lester, Pensylvannia. He summarized his assessment of this approach by saying, "The Newport Design/Build process is relatively straight forward. It becomes a rousing success with good communication and team work. (Briggs - 1992)

The Head of the Architectural Design Branch, Mr. J. Cambell made the following comments about Newport Design/Build, "It makes great in-house work! It allows designers to do the fun parts and eliminates the construction documents burden on a shrinking technical staff. It has excellent potential for quickly getting a facility available to our clients!" (Briggs-1992)

Captain L.P. Scullion, who was involved in the process through the Acquisition Department at Northern Division stated his enthusiastic support in the following terms, Newport Design/Build keeps the customer happy...(and delivers) quality sooner (and at) less cost. He believes that, "the current application is just the tip of the iceberg." He feels that it will eventually be used on maintenance and repair projects as well. (Briggs-1992)

5.5 Bidding & Award Phase

A Pre-proposal meeting was held 30 days after sending out the solicitations. This allowed potential bidders to ask any questions regarding the IFB specifications or drawings and provided an opportunity to visit the site. As a result of the questions asked at this meeting, an amendment to the solicitation was issued to clarify certain items. There were six bidders, all well below the government estimate. The low bidder came in 21.2% below the government estimate. The award was made to the low bidder for $727,930.

5.6 Design Phase (Phase A)

Under the Newport IFB, the contractor is required to have under contract or in-house, professional architects and engineers, registered in the state of the project. They must be regularly engaged in the design of similar facilities for a minimum of three years, and must have designed and had constructed 3 projects of comparable magnitude within the last 5 years. (NFGS-DB-01301-4/93)

The contract allowed 105 days from date of award for the contractor to prepare a complete set of working drawings, "accurate and explicit enough to show compliance with the IFB requirements

and to permit construction." (NFGS-DB-01301 - April 93) Instead of having him turn in 35% completion for review, they let him continue through 100% design then reviewed it at the end. In this case the contractor completed the design several weeks early, but required modifications after the government review, which put the contractor right back on schedule. The actual construction phase could not begin prior to government approval of completed design, but early completion would have allowed the contractor to begin construction early as well.

Mr. Briggs stated that the design phase went fairly smoothly, because they had a design/builder who took pride in his work, and welcomed the opportunity to work closely with the A/E in the design phase. They were able to get the contractor to retain an intern architect from the A/E staff to assist on site as the contractor's quality control representative. This provided a valuable sense of continuity and helped create a more unified team throughout the entire project.

5.7 Construction Phase (Phase B)

Construction went very rapidly starting on 5 June 1990, with completion expected in December. The contractor finished a month and a half early. Part of the efficiency was due to the fact that the contractor was allowed to use the system of his choice, which in this case turned out to be Butler buildings, because he was familiar with this system, and could install it quickly. There were 14 change orders on the contract, 5 of which were design rather than site related. The total cost of all these changes was $43,566 of which $14,107 was design related, meaning that the original IFB package contained incorrect or missing design criteria. The balance of $34,819 was due to site related changes from unforeseen site conditions or utility conflicts. Since the Navy had provided a 100% complete design for this part of the facility, liability for all such changes remained with the Navy as with a conventional procurement.

Contract Changes for Brunswick, Maine, Child Development Center

C/O	Design Changes	Cost	C/O	Site Changes	Cost
1	Roof Color	$4,362.00	2	Floor Elevation	$3,944.00
6	WP, TP, CW	$3,545.00	3	Trench Drain	($4,182.00)
8	Fire Rated Ceiling	$0.00	4	High Voltage	$19,231.00
11	Diaper Vents	$1,876.00	5	Curbing	$3,379.00
13	MDEP Oil Tank	$4,324.00	7	Drain Pipe	$0.00
			9	Bollard Paving	($823.00)
			10	Broken Water Main	$1,654.00
			12	Broken Water Main	$6,611.00
			14	Oil Used by "K"	($355.00)
	Design Changes	$14,107.00	0	Site Changes	$29,459.00

Table 5.1 Contract Changes at Brunswick Child Care Center

5.8 Perspective of Resident Officer in Charge of Construction (ROICC)

Lt Allan M. Wironen was the Assistant Resident Officer in Charge of Construction or AROICC on the job, and as such he was fully responsible for all aspects of contract administration. He had earlier been in the office where the very first Navy Newport Design/Build job had been attempted in Newport, Rhode Island on a small Family Services Center. Thus he was somewhat familiar, with the procedural, philosophical and contractual difference in administering a design/build job.

He had an enthusiastic and positive overall impression of the Newport method, and summed it up by saying, "This is the ONLY way to do construction!" When asked what effect if any he felt the process had on change orders in the field, he indicated that most problems that came up, which

would normally have been change orders under a conventional contract became the responsibility of the contractor. He said it was easier to execute the changes when they became necessary also because rather than having to send the problem back to the A/E and wait for a response, it was the contractor's responsibility to come up with acceptable designs for the changes, and they had to comply with the original IFB requirements as well. Thus there were fewer delays, and they could not be blamed on the government, which provided additional impetus for rapid solutions.

Although the contractor was required to provide his own Contractor Quality Control inspector, this individual also served more or less as a superintendent, which caused some problems. However, the key is to have a good independent Navy construction representative (Conrep) do occasional spot checks on the quality and degree of compliance with the plans and specifications and with local codes. A good conrep makes a big difference on how well the job goes.

He said that one weakness he noted was that since the CQC was also the superintendent, he allowed the submittal review and approval process to get behind, and he lost control of it. But because of the nature of the design, virtually everything the contractor wanted to use was in effect preapproved by virtue of the approval of the design and specifications. Unlike the standard Navy specifications, which cannot use name brands or proprietary specifications, the contractor doing the design/build is at liberty to specify the exact product, material or system he intends to use, by manufacturer and model number if appropriate. This fact alone relieves the contractor from a significant burden, and a serious risk that products he intends to use, or hopes to get waivers on will not be allowed. It also means that the contractor can begin procurement of long lead items

and special equipment, before formal approval to commence construction in necessary.

When asked whether the contract method seemed to affect the relationship with the contractor for better or for worse, he replied that he felt it had a very positive impact on the contractor and his relationship with the ROICC office personnel. He explained that this appeared to result from a higher degree of ownership of design manifested by the contractor. He seemed to feel a greater level of responsibility for the project and he took more initiative as a result. He felt that the morale on the job and the relationship with the contractor were greatly improved due to the use of the Newport Design/Build method. He indicated that the only possible improvement he could recommend would be to combine the Newport Design/Build method with Partnering to obtain the best possible working relationship and ideal working conditions.

5.9 Lesson Learned

The most striking fact was the overall savings in project delivery time which would have been 60 months using standard procedures, but was only 29 months using the Newport Method. The overall analysis according to Briggs and Wironen is that the Newport Design Build Method clearly "proved to be a viable alternative to the traditional design-bid-construction procurement process." However they provided the following 'lessons learned' based on this experience:

1. A prebid meeting should be held to ensure that all prospective bidders understand the scope and the New Port Design/Build Process.

2. The level of effort required to administer phase A of the design/build contract is

equivalent to the amount of effort required to manage an in-house design.

3. Both the Design Manager at the EFD and the ROICC in the field must conscientiously track small details to ensure obscure items are not overlooked.

4. The Design Manager and the ROICC must work closely together and keep each other aware of all discussions with the design/build contractor and any decisions made.

5. Written contractor inquiries should receive expedited attention with maximum use of facsimile transmission to reduce government turnaround time.

6. The CQC should be a separate position apart from superintendent or any other job. Ideally he would be part of the design team with insight into the intent of the design.

7. The Project Superintendent rather than the CQC should be responsible for submitting proposed solutions to design or construction problems encountered.

8. The submittals should be sent to the ROICC prior to installation, and as a precondition to authorizing payments for those items. This would serve as an incentive to the contractor.

9. Allow ROICC to handle all contract modifications, including those required during phase Phase A, design. This helps establish corporate knowledge prior to the construction phase and provides continuity to the contract.

10. A schedule of prices including a line item for design (2.5%-4.5%) should be required within 5 days of approval of design and authorization to proceed with construction.

5.10 Summary of Results of Case Study

Based on the assessment from both the design manager and the ROICC who were responsible for administering the contract, it would appear that the use of the Newport Design/Build method is certainly a valid alternative to conventional procurement methods. In this particular case, the overall cost including design cost turned out to be 33% less than the average cost experience constructing similar child care centers using the conventional method. The total cost of all change orders for actual field construction changes was $29,459. This produces a change order rate of approximately 4% of the award amount ($29,459/$727,930 = .04047). This compares very favorably to the 11.25% change order rate experienced on similar child care centers constructed using traditional methods. The total time required for project delivery from project authorization to completion was effectively cut in half from the normal 60 month procurement cycle to only 29 months.

Appendix C contains project data and similar evidence of savings (31.5%) for Water Tank projects, which also saved slightly over a year in execution time. Appendix D contains project data comparing two training ranges, one done using design/build and the other conventional. The resulting cost savings are in excess of 25% and time saved is almost a year and a half. In view of the reduced cost, the reduction in the change order rate, and the accelerated project delivery, it would be difficult to come to any conclusion other than that the Newport Design/Build Method produces extraordinary results. It is no wonder that LT Wironen would exclaim, "This is the only way to do construction!"

Chapter 6 - Conclusions and Recommendations.

6.1 Design/Build offers opportunities for Quantifiable Cost and Time Savings.

The data presented in chapter 4 and 5 clearly indicate that combining both design and construction in a single contractual entity actually does produce measurable improvements in performance. The results of this research strongly support the validity of the theoretical advantages of administering a single contract with a single point of accountability. As many private sector owners have known for years, and as public agencies have been discovering recently, design/build can be a much more cost effective solution for facilities procurement than the conventional design/bid/build process. It is astonishing that after decades of experience with design/build in the private sector, and almost 20 years of congressionally mandated use in DOD's family housing there is so little published research on this subject. Except for a few subjective surveys,there are apparently no published studies attempting to correlate in quantifiable terms the actual performance results of design/build contracts with the highly touted theoretical advantages. This study, though meager in scope, establishes the first empirical link between the type of contract delivery method, and quantifiable results such as savings relative to conventional procurement methods, change order rates, contract duration, etc. The magnitude of these savings ranged from 15.5% to 21.9% depending on the type of design/build mechanism employed. This is remarkable, particularly in light of the potential savings which could be generated if this method were extensively utilized throughout state and Federal Governments.

Perhaps even more remarkable than the validation of substantial cost savings reported is the considerable reduction in project delivery time which in some cases was actually cut in half! This

appears to be largely due to the elimination of the lengthy process required to get a design team under contract, and the lag time between design and construction. There is also an added incentive for the contractor since any reduction in design time allows the contractorthe contractor to begin construction that much earlier. This allows the Design/Build team to benefit directly by early design completion. In addition, since the design/build team is in the driver's seat from the inception of the project, there is no need to wait for design completion to begin ordering long lead items, and special fabrications or equipment. Finally, the contractor is at liberty to use what he believes to be the quickest, most efficient construction systems, and does not have to go through lengthy submittal processes for approval of substitutions or waivers.

The issue of actual performance history of design/build with regard to change order rates is muddied by the inclusion of design changes in the accounting process. This occurs since both the design and the construction phase are administered under a single contract. Thus all changes to the requirements stated in the IFB package are handled the same whether they relate to design or construction changes. Ideally, the contractor would be able to identify such problems early enough in the design phase to allow an engineering solution rather than a field modification.

6.2 When is Design/Build Most Appropriate?

For many decades, design/build was used primarily in the private sector for complex industrial plants such as petrochemical. This tradition probably derives from the fact that these industries were process oriented rather than aesthetically oriented. The intent was to meet certain functional or performance requirements without regard to how they were met. The other factor that

probably contributed to this tendency was the esoteric nature of the task itself, which by its very complexity tended to force integration of design, manufacturing and construction. Many of the largest construction firms capitalized on this need and provided the kind of one stop shopping that the heavy industrial market demanded. They had sufficient resources to assemble a formidable team of interdisciplinary engineers, and construction savvy specialists with the expertise to bring continuity and coherence to the design and installation of extremely complex industrial plants. Thus it would seem that the origins of traditional design/build were based more on the practical necessity of the industrial market and the capability of the heavy construction industry to meet that demand, rather than on the theoretical advantages of a more pristine contractual mechanism.

How this traditional stereotype of design/build evolved into the conventional wisdom currently in vogue at NAVFAC and apparently several other Federal Agencies is somewhat of a mystery. The present policy guidance with regard to design/build within NAVFAC is based on the premise that the traditional design/bid/build strategy should normally be used unless the government is:

a) Unsure of exactly what it wants (complex industrial facilities) b) Lacks confidence as to the cost (Experimental, highly technical, no counterpart in private sector) c) Has no reasonable expectation of competition. d) Has valid requirement to accelerate the procurement schedule.

These requirements are defined in a May 1988 document entitled, Newport Design/Build-A study on Integrating the Newport Design/Build Strategy into the NAVFACENGCOM Facilities Design and Acquisition Process." This document was prepared after several pilot projects had been performed but before the Newport Design/Build method had established an adequate track record to ascertain its viability with respect to cost performance, time savings, etc.

These guidelines appear to derive from the FAR requirements for using competitive negotiations and justifying the use of factors other than price upon which to base the award. This indicates that the issue of negotiated procurements (which require special conditions be met to preclude a noncompetitive process) was probably confused with the issue of non-traditional procurement strategies such as design/build, and the use of performance rather than prescriptive specifications.

The policy that "NDB is best used for routine, general purpose facilities" was also disseminated by attachment 1 of this same document. Page 5 of this document however was more broad in its guidance stating that, "Newport Design/Build contracting strategy is recommended for use in the acquisition of facility types that the construction community can readily relate to and translate the performance criteria into actual construction." Examples of such facilities were given as follows: General use facilities (Admin, Community Facilities), Bachelor Enlisted Quarters (BEQ's), Warehouses, Water and Fuel tanks, Building with repetitive design features.

Based on the background research in preparing for this paper, it is the opinion of this author that NAVFAC has developed a unique and very useful hybrid form of design/build which has enormous potential in terms of reduced cost and shortened project delivery, fewer claims and litigation, and less administrative overhead to manage. However, based on the trends of the past 8 years since the Newport Design/Build method was first introduced, it is vastly underutilized. We are not exploiting a very valuable technique for enhancing the value of our services by decreasing cost and time for project execution, while reducing required administrative effort and claims. Design/Build can also play a valuable role in expediting obligation of funds.

The Navy began on the basic premise that Design/Build was best suited for simple projects (Housing, etc.). The private sector, on the other hand, has moved from a heavy industrial usage toward a broader commercial utilization of Design/Build in mid 80's. As more Design/build contractors gain experience in commercial Design/build, the pool of competent design/build firms will grow. Although most Navy Design/Build has been fairly simple, there are striking exceptions such as Medical / Dental Clinics, a Centrifuge Trainer, and a CB Material Transit Facility.

The FCC Study of Federal agency experiences w/ Design/build counters the conventional wisdom that the use of design/build should be limited to a narrow range of facility types. The study covered 27 buildings ranging from simple office to complex & sophisticated. ***Design/build was perceived to be more effective than conventional for all building types***. It reports that, "The information collected by the committee shows clearly that the design/build approach has been used successfully by a number of federal agencies for a wide variety of projects of varying complexity located in many different regions of the US.... The results have been at least as good as with the traditional approach, and in many respects the results have been significantly better." In fact, when rated against comparable conventional jobs (which served as the control standard of 5 on a scale of 0 to 10) the design/build projects were rated an average of 6.85 for user satisfaction, 7.23 for cost savings, 7.4 for reduced change orders, and 8.12 for quicker delivery.

Interestingly, the highest effectiveness rating was obtained on industrial & laboratories (fairly complex). This is another indicator that the taboo on using design/build for buildings of intermediate to high complexity is based on a myth, which is without any factual basis whatever.

The graph in Figure 6.1 below indicates that all categories of buildings were judged to be more succcessful when build using design/build procurement strategies. However, the most striking fact is the noticeably higher ratings in cost and time savings for both industrial & laboratory buildings. Even highly complex buildings fared better than simple office buildings when it came to cost and time saving elements. Perhaps there is actually more opportunity for savings on such projects.

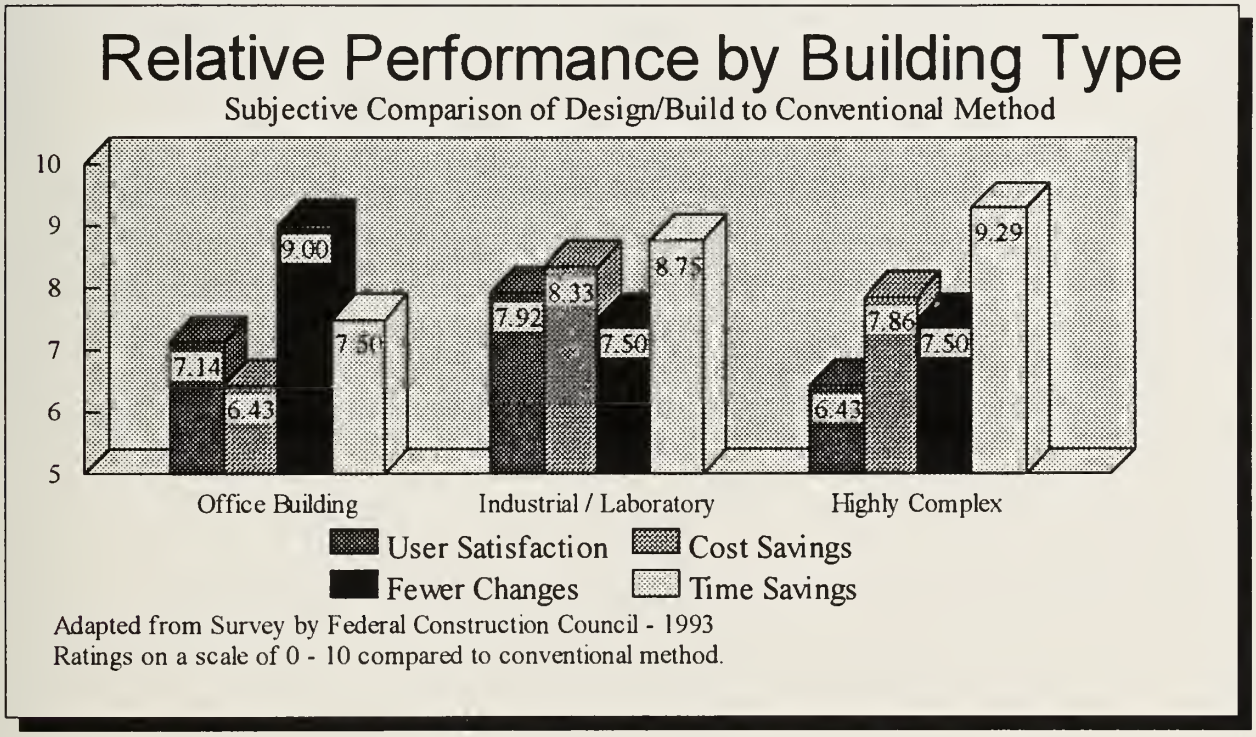

Figure 6.1 Design/build v Conventional by Building Complexity

6.3 When is a particular Form of Design/Build Most Appropriate?

Another area that was addresed by the FCC study was the issue of which type of design/build organization was most effect in delivering the benefits of design/build.

The graph in Figure 6.2 below summarizes the findings of this survey.

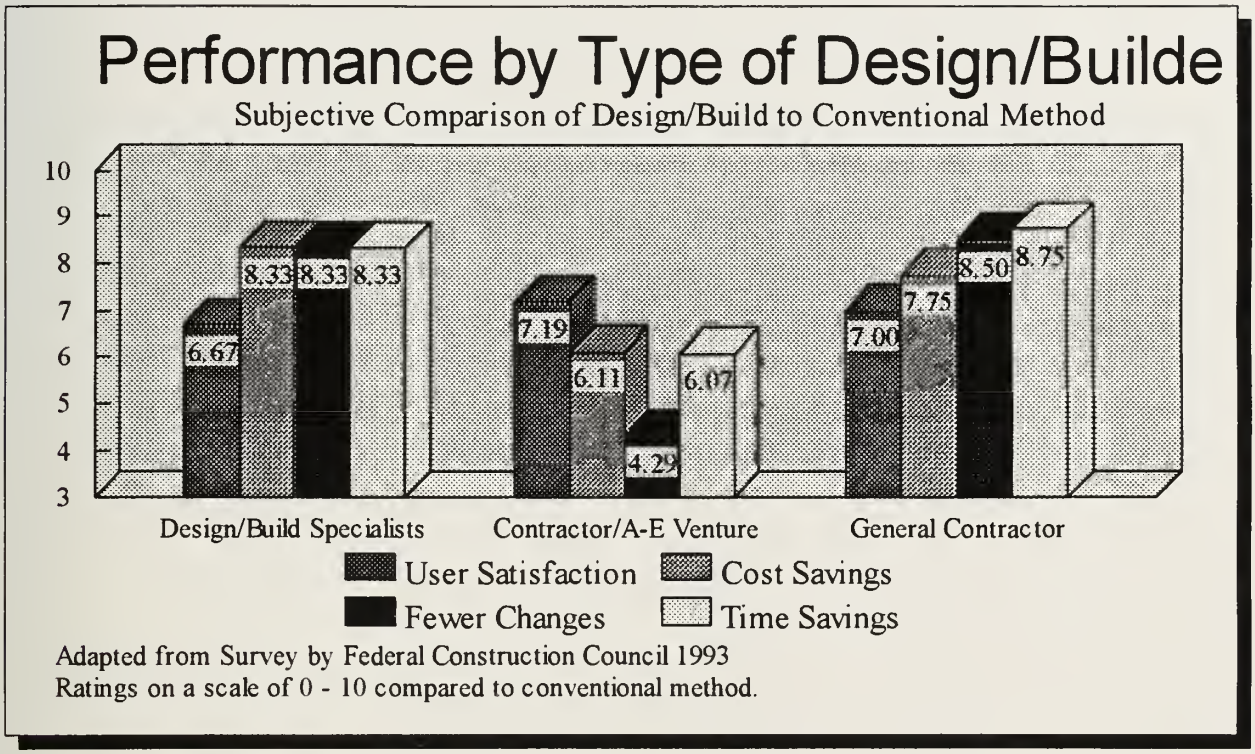

Figure 6.2 Design/Build Efficiency by Design/Build Organization

The above data indicates that Joint ventures between contractors and A/E's are perceived to be the least effective in delivering the desired performance. Yet despite the weak showing when compared to integrated design/build firms and teams led by general contractors, design/build even with a joint venture appeared to be more successful than the conventional methods.

The level of design completion of the performance spec and schematic drawings prior to issuance for competitive proposals or bids also affects the results significantly. The best results were obtained when the design was between 15-35% complete. Less than 15% evidently doesn't provide adequate direction to the design/build team, while much over 35% may be restrictive.

The graph is Figure 6.3 illustrates the results of this survey with respect to design completion.

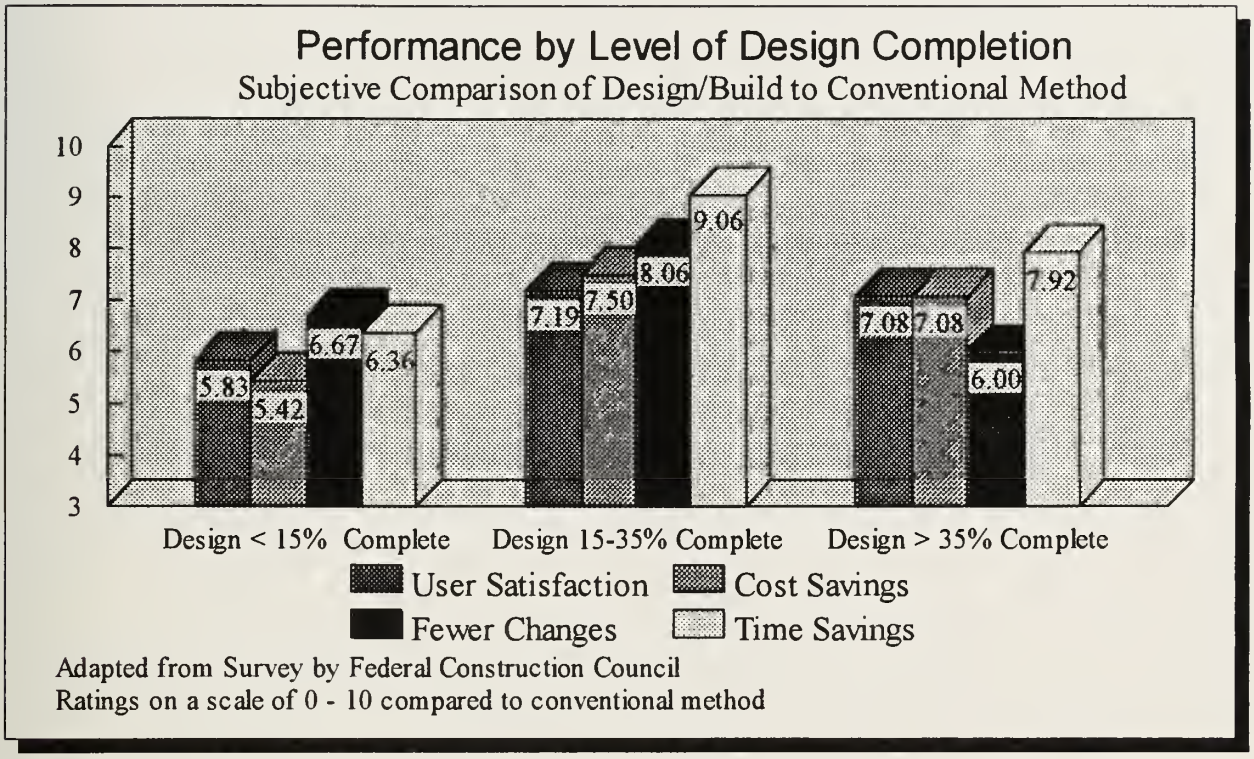

Figure 6.3 Design/Build Efficiency by Level of Design Completion

The data in figure 6.3 should give pause for thought to agencies which are working with design/build outside of the optimal performance range. Appendix F, is a Table summarizing the results of the ASCE survey conducted in 1992. It is interesting to note that a number of Federal agencies polled in the ASCE survey indicated that the level of design they typically use falls within the optimal range. However there were some which started as low as 0% and went up to 50%.

Clearly, this is an area which needs further research, particularly since little if any data is available relating to the use of the two-step method. Additionally, it is not clear that the family housing program, which uses the source selection procedure, has ever been compared to conventional or

the Newport method. It may be appropriate to take a hard look at the family housing program to see if Newport Design/Build might be more appropriate there. Currently, the status quo is:

1. Two-step technical proposal process is accepted as most suited to very complex projects.
   Two-step was not adequately tested, but NAVFAC disapproves of its complexity.

2. One-step source selection was seen as ideal for intermediate range projects

3. Newport Design/build was seen as best suited to simple & unsophisticated projects.
   This policy apparently stems from lack of extensive performance guidespecs.
   Appears to be nothing inherent in the process that would limit its use.
   Based on performance results it may be appropriate to review & broaden scope.

6.4 Lessons learned from Early Design/Build Projects.

The following lessons have been learned on the basis of experience acquired to date:

1. Need to have a fully defined performance specifications.
2. Important to have some degree of quality assurance for contractor's selection of A/E.
3. It is wise to have some form of independent inspection.
4. Contractor's Quality Control (CQC) should be designer of record & must be accountable

6.5 Recommendations for Continued Use and Improvement of Design/Build Techniques.

Although significant progress has been made in standardizing policy & performance

guidespecs, much remains to be done. The following actions are recommended:

1. Guidespecs should be developed for larger & more complex bldgs
2. NAVFAC Policy should direct use of design/build whenever possible
3. NAVFAC should attempt to learn from mistakes & successes of other agencies.
4. NAVFAC could issue lists of pre-approved A-E's for complex or critical projects.
5. When RFP requires significant effort, proposers should receive honorarium.
6. When IFB used, require A/E experience/competence as if slating (like Brooks Act)

6.6 Suggestions for Future Research.

The following ideas for additional exploration and research on this topic are recommended:

1. Study the impact of design/build contracts on actual administrative workload.

Manhours charged to each job can be compared, level of effort estimated.

Should see improvements in administrative efficiency as it becomes more common.

2. Analyze actual rather than estimated time for procurement under traditional method.

Data would probably have to be collected on case by case basis, but is available.

3. Similar definitive performance studies should be conducted for other Federal Agencies.

Sufficient track record exists, data could be collected & analyzed empirically.

4. System for annual feedback of design/build performance results should be established.

   NAVFAC already has excellent data collection, it could be easily modified to identify/report Design/build projects.

   Congress should require each agency to report relative efficiency of Design/build.

5. Licensing laws for each state should be surveyed in the context of impact on Design/Build.

   Determine what impact these laws have had on Design/build.

   Can/Should Federal Agencies use Sovereign Immunity to avoid this problem?

6. A detailed study of frequency, size & types of change orders in Design/Build

   FCC study was good but only opinions and subjective estimates were surveyed.

   Hard numbers need to be compiled and analyzed for each agency.

7. An analysis of fundamental differences & pros/cons of various standard forms.

   Each agency has developed unique contracts, with special features & provisions.

8. Study possibility of unifying various methods into a single methodology.

   Unified effort should be made to find 2-3 distinct types of Design/build throughout all the federal agencies & standardize them.

   This approach is recommended by ASCE policy statement & report.

9. Report actual impact, if any, on claims, disputes, litigation frequency & $ volume.

Although much speculation & opinion, no empirical data has been published.

Thus based on the data from the initial limited studyof two design/build methods within NAVFAC, the results are extremely positive. The reported 50% reduction in the traditional delivery schedule was particularly impressive. It seems clear that the preliminary results and evident advantages of this technique warrant broader application throughout the entire NAVFAC system. It is time to stop considering design/build as an experimental program, and begin to move it into the mainstream as a fully viable alternative to the conventional design/bid/build strategy.

Its popularity in the private sector has been growing for 20 years, and for good reason. Owners have been pleased with the willingness to provide a guaranteed price up front, and then deliver the design and construction without the usual haggling and bickering over every ambiguity or error in the documents. They are pleased with the ability of design build contractors to make a time commitment and stick with it. The schedule and claims games played in the traditional process are largely eliminated.

It is recommended that additional research be conducted by the NAVY as a history of built projects evolves. An ongoing and comprehensive study should be commissioned to verify and validate the specific impact of design build as a contract delivery mechanism on such factors as:

1) Delivery time. Are design/build contractors actually more likely to achieve required completion dates? Do the length of projects actually see 50% reduction on the average

design/build project? Are time extensions less frequent with design/build?

2) Cost. Is the reported savings potential of 22% actually valid. Can these savings be obtained on other larger projects as well? Are we actually getting more building for the money?

3) Increase (or possibly decrease once staff have adjusted to it) in administration time and cost or agencies overhead. Is this a permanent factor, or only a result of the newness within the NAVFAC system and unfamiliarity of its personnel with Design/Build.

4) Possible adverse consequences with regard to removing the time honored and tested mechanism for providing checks and balances within the construction industry. If the architect is no longer on the site to guard the owner against defective work, who is? Is a third independent party needed to make the process unbiased and well controlled?

5) More in depth analysis of difference in change order rates, overall cost growth, and unresolved disputes, or cases litigated for the design/build type contracts.

Perhaps an area of research that would be rewarding to pursue might be the correlation between efforts made by other Federal and even DOD agencies in this area, and what their experiences, and successes or failures might have been. In particular, GSA has been extremely active lately in using the design/build technique. The Army COE, and especially the EPA have been fairly aggressive in their pursuit of these nontraditional contracting techniques.

6.7 Conclusion

In conclusion, it is recommended that NAVFACENGCOM pursue a more aggressive role in exploring potential benefits which the private sector has long acknowledged to be a more flexible and dynamic approach to construction. It is further recommended that NAVFAC's current policy of limiting the use of this technique to certain very narrowly defined building types and to fairly small, insignificant structures be vastly increased to include a much broader scope and volume of NAVFAC's annual construction volume. Such a policy would correlate better with both the private sector and public sector experience and the findings of the ASCE's Task Force of Design/Build which reported that Design/Build is "perceived to be beneficial on a variety of project types" and "has been successfully used on complex power plants and chemical process facilities and on simple straightforward office buildings and family housing. ***In fact, there is no reason that design/build cannot be used on most types of construction projects***" (Design-Build in the Federal Sector 1992)

If we can cut a year or more from scheduled execution time, deliver a quality project for at least 20% less than would it normally costs, and experience fewer administrative change orders and claims in the process, why limit it to only 3% of the total Military Construction program? This procedure has the potential of saving literally hundreds of millions of dollars annually for our customers, and providing better value for their dollar. These experiments have shown repeatedly and conclusively that design/build works. Congressional restrictions on the use of design/build have been lifted as of 1992. We now have the knowledge and expertise, and a well thought out process for executing design/build projects. All that remains is to expand the scope of implementation through official policy guidance at the NAVFAC headquarters level.

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NAVFAC PROJECTS USING ALL DESIGN/BUILD METHODS - FY85 to 95

FY	P #	ACTIVITY	PROJECT TITLE	Design/Build Method	($000) Prg Amt	($000) Awerd	($000) Fin Cost	Sevings PA-Awerd	% Sevinge	($000) $ Growth	% Growth	($000) Net Seved	Net % Seved	FY Awerd	Awerded	Completed	Months
85	317	Newport NETC	Family Servicee Center	Newport	$1,630	$1,015	$1,015	$615	37.73%	$0	0.00%	$615	37.73%	85	07/30/85	07/30/86	12.0
	Avg	$1,630	1985	Totele:	$1,830												
85	819	Charleston NWS	Potable Water Stor Tank	Newport-NO	$690	$731	$743	($41)	-5.94%	$12	1.64%	($53)	-7.66%	86	06/11/86	07/11/87	13.0
	Avg	$890	1988	Totels:	$890												
86	612	Camp Elmore, VA	Combat Vehicle Maint Fac	Two-Step	$715	$914	Cencelled due to toxio weate on eite - Not inoluded in Fy 87					program totele					
86	614	Camp Elmore, VA	Flt Marine Suprt Warehae	Two-Step	$3,280	$5,095	Cencelled due to toxio weate on eite - Not inoluded in Fy 87					program totele					
87	179	Miramer CA, NAS	Bachelor Enlisted Qtrs	One-Step	$9,200	$8,490	$8,490	$710	7.72%	$0	0.00%	$710	7.72%	87	09/01/87	05/10/89	20.3
87	905	MCB Camp Pendleton, CA	Bachelor Enlisted Qtrs	One-Step	$12,300	$11,628	$11,628	$672	5.46%	$0	0.00%	$672	5.46%	87	09/01/87	05/10/89	20.3
86	210	Cecil Field NAS	Air Combat Traing Range	Newport	$1,200	$1,054	$1,054	$146	12.17%	$0	0.00%	$146	12.17%	87	07/01/87	03/10/88	8.3
	Avg	$7,567	1987	Totele:	$22,700												
86	421	NCBC Port Hueneme, CA	CB Meteriel Tranait Fac	One-Step	$6,960	$5,967	$5,967	$993	14.27%	$0	0.00%	$993	14.27%	88	11/09/87	$32,456	12.0
88	083	MCDEC Quantico, VA	Bachelor Enlieted Qtre	One-Step	$2,950	$2,847	$2,847	$103	3.49%	$0	0.00%	$103	3.49%	88	06/23/88	11/23/89	17.0
	Avg	$4,955	1988	Totele:	$9,910												
89	368	Great Lakes, Il, PWC	Water Storage Tanks	Newport	$1,930	$1,078	$1,078	$852	44.15%	$0	0.00%	$852	44.15%	89	12/23/88	08/19/90	19.9
	Avg	$1,930	1989	Totele:	$1,930												
90	847	Earle NJ, NWS	Family Servicea Center	Newport	$1,000	$794	$871	$206	20.60%	$77	9.70%	$129	12.90%	90	01/23/90	02/02/91	12.3
	Avg	$1,000	1990	Totele:	$1,000												
90	993	Brunawick ME, NAS	Child Development Center	Newport-NO	$7,500	$5,842	$6,493	$1,658	22.11%	$651	11.14%	$1,007	13.43%	91	10/17/90	08/21/92	22.2
90	991	New London, CT, NSB	Child Development Center	Newport	$1,000	$838	$959	$162	16.20%	$121	14.44%	$41	4.10%	91	10/23/90	05/13/92	18.7
90	994	Kittery ME, Portamouth NSY	Child Development Center	Newport	$1,000	$782	$939	$218	21.80%	$157	20.08%	$61	6.10%	91	10/23/90	01/01/92	14.3
90	996	Dahlgren VA, NSWCTR DIV	Child Development Center	Newport-NO	$570	$647	$647	($77)	-13.51%	$0	0.00%	($77)	-13.51%	91	08/08/91	08/08/92	12.0
	Avg	$2,518	1991	Totele:	$10,070	$8,109	$9,038	$1,961	11.85%	$929	11.41%	$1,032	2.53%				17
88	356	NAB, Little Creek, VA	Sea Lift Support	Two-Step	$6,600	$6,600											
90	995	NAS Fallon NV	Child Development Center	One-Step	$1,000	$1,074	$1,076	($74)	-7.40%	$2	0.19%	($76)	-7.60%	92	12/03/91	01/17/93	13.5
90	997	NSY Puget Sound	Child Development Center	One-Step	$1,000	$988	$1,036	$12	1.20%	$48	4.86%	($36)	-3.60%	92	12/03/91	01/17/93	13.5
90	106	NAS Lemoore, CA	Centrifuge Trainer	One-Step	$2,100	$2,064	$2,306	$36	1.71%	$242	11.72%	($206)	-9.81%	92	06/14/92	07/01/93	12.6
90	606	San Diego, CA, NMC SW Re	Parking Structure	Newport	$7,500	$5,842	$6,493	$1,658	22.11%	$651	11.14%	$1,007	13.43%	92	10/17/90	08/21/92	22.2
91	407	Child Development Center	NETC Newport, RI	Newport	$1,200	$1,101								92	04/15/92		
92	202	Cold Storage Warehouse	NTC Orlando, FL	two-atep	$2,150	$2,046								92	08/13/92		
	Avg	$3,079	1992	Totele:	$21,550	$19,715											22
92	271	Cold Storage Warehouse	Peneacola FL, FISC	two-atep	$5,700	$3,865								93	03/10/93		
92	175	Child Development Center	NTC Orlando, FL	Newport	$4,000	$3,433								93	11/25/92		
	Avg	$4,850	1993	Totele:	$9,700	$7,298											
94	705	Child Development Center	MCLB, Albany GA	Newport	$830									94			
94	387	Child Development Center	NETC Newport, RI	Newport	$1,200									94			
94	101	Child Development Center	NH Bethesda, MD	Newport	$2,900									94			
94	313	Child Development Center	NDW Washington	Newport	$1,500									94			
94	467	Bachelor Enliated Quarters	NAS Jackeonville, FL	Newport	$14,000									94			
	Avg	$4,086	1994	Totele:	$20,430												
95	141	Security HQ	MCRD Parris Is, SC	Newport	$1,250									95			
95	202	Child Development Center	NAS Barbers Pt, HI	Newport	$2,700									95			
95	039	Child Development Center	NSS Washington DC	Newport	$1,270									95			
95	623	Child Development Center	MCAS Kaneohe, HI	Newport	$4,250									95			
95	297	Bachelor Enliated Quarters	NYS Bremerton, WA	Newport	$13,500									95			
95	310	Child Development Center	MCRD Parris Is, SC	Newport	$2,550									95			
95	774	Child Development Center	NAS Cecil Field, FL	Newport	$2,200									95			
95	116	Child Development Center	NAS Peneacola, FL	Newport	$2,430									95			
	Avg	$3,789	1995	Totele:	$30,150												

Project Data for FY 90 NAVFAC Child Care Centers

CHILD CARE CENTERS USING "1-STEP SOURCE SELECTION DESIGN/BUILD" FY90

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	# Months
90	Bremerton Puget Snd, WA,	Child Development Center	$1,000	$988	$1,006	$12	1.20%	$18	1.82%	$18	$63	($87)	-8.70%	12/03/91	01/24/93	13.7
90	Fallon NV, NAS	Child Development Center	$1,000	$1,074	$1,078	($74)	-7.40%	$4	0.37%	$11	$71	($160)	-16.00%	12/03/91	01/24/93	13.7
		TOTAL	$1,000	$1,031	$1,042	($31)	-3.10%	$11	1.07%	$15	$67	($124)	-12.35%			13.7

CHILD CARE CENTERS USING "NEWPORT DESIGN/BUILD METHOD" FY90

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Contract	In-Housa Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	# Months
90	Brunswick ME, NAS	Child Development Center	$1,000	$794	$871	$206	20.60%	$77	9.70%	$1	$77	$51	5.10%	01/23/90	02/02/91	12.3
90	New London, CT, NSB	Child Development Center	$1,000	$838	$959	$162	16.20%	$121	14.44%	$41	$79	($79)	-7.90%	10/23/90	05/13/92	18.7
90	Kittery ME, Portsmouth NSY	Child Development Center	$1,000	$782	$939	$218	21.80%	$157	20.08%	$1	$103	($43)	-4.30%	10/23/90	01/01/92	14.3
90	Dahlgren VA, NSWCTR DIV	Child Development Center	$1,000	$1,043	$1,044	($43)	-4.30%	$1	0.10%	$79	$49	($172)	-17.20%	09/04/91	03/21/93	18.5
		TOTAL	$1,000	$864	$953	$136	13.58%	$89	10.30%	$31	$77	($61)	-6.08%			16.0

CHILD CARE CENTERS USING STANDARD PROJECT DELIVERY METHOD FY90

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	** # Months
90	San Diego CA, NS	Child Care Center	$1,000	$979	$1,015	$21	2.10%	$36	3.68%	407	43	($465)	-46.50%	02/22/91	03/12/92	24.6
90	Beaufort, SC, MCAS	Child Development Center	$970	$924	$1,315	$46	4.74%	$391	42.32%	85	14	($444)	-45.77%	10/26/90	10/17/91	23.7
90	Monterey CA, NPGS	Child Development Center	$2,000	$1,905	$2,180	$95	4.75%	$275	14.44%	277	51	($508)	-25.40%	01/16/91	06/15/92	29.0
90	Great Lakes, IL, NTC	Child Development Center	$2,300	$2,190	$2,189	$110	4.78%	($1)	-0.05%	407	107	($403)	-17.52%	11/02/90	07/24/91	20.7
90	San Diego CA, NTC	Child Care Center	$2,350	$2,085	$2,293	$265	11.28%	$208	9.98%	239	406	($588)	-25.02%	10/25/90	10/05/91	23.3
		TOTAL	$1,724	$1,617	$1,798	$107	6.23%	$182	11.25%	283	124.2	($482)	-27.94%			24.3

** 12 months have been added to the # Months for completion column to account for the time to award to an A/E and Dasign in standard method.

AVERAGE NET SAVINGS USING 1-STEP SOURCE SELECTION METHOD FY90

90 ONE-STEP DESIGN/BUILD CHILD CARE CENTERS	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Savings	In-House Savings	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	Months Saved
TOTAL ADJUSTED SAVINGS	$1,000	$1,093	$982	($93)	-9.33%	($111)	-10.18%	$150	$5	$156	15.59%			10.5

AVERAGE NET SAVINGS USING "NEWPORT DESIGN/BUILD" METHOD FY90

90 NEWPORT DESIGN/BUILD CHILD CARE CENTERS	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Savings	In-House Savings	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	Months Saved
TOTAL ADJUSTED SAVINGS	$1,000	$927	$918	$73	7.35%	($9)	-0.95%	$134	($5)	$219	21.86%			8.3

Appendix B

Project Data for NAVFAC Water Tank Projects

WATER TANK PROJECTS USING "NEWPORT DESIGN/BUILD METHOD"

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) $ Growt	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	# Months
85	Charleston NWS	Potable Water Stor Tank	$1,630	$1,015	$1,015	$615	37.73%	$0	0.00%			$615	37.73%	07/30/85	07/30/86	12.0
89	Great Lakes, Il, PWC	Water Storage Tanks	$1,930	$1,078	$1,078	$852	44.15%	$0	0.00%			$852	44.15%	12/23/88	08/19/90	19.9
	TOTAL		$1,780	$1,047	$1,047	$734	41.21%	$0	0.00%			$734	41.21%			15.9

WATER TANK PROJECTS USING STANDARD METHOD

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) $ Growt	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	# Months
91	29 Palms, CA, MAGCC	Potable Water Stor Tank	$4,600	$2,994	$2,996	$1,606	34.91%	$2	0.07%			$1,604	34.87%	09/20/91	11/10/92	25.7
90	Concord, CA, NWS	Water Systems Imprvmt	$3,200	$3,600	$3,688	($400)	-12.50%	$88	2.44%			($488)	-15.25%	06/05/91	11/05/92	29.1
91	Mayport, FL, NS	Potable Water Sys Impr	$4,950	$4,234	$4,830	$716	14.46%	$596	14.08%			$120	2.42%	08/23/91	03/31/93	31.3
	TOTAL		$4,250	$3,609	$3,838	$641	15.07%	$228	6.32%			$412	9.69%			28.7

** 12 months have been added to the # Months for completion column to account for the time to award to an A/E and Design in standard method.

AVERAGE NET SAVINGS USING "NEWPORT DESIGN/BUILD" METHOD

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) $ Growt	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	Months Saved
	TOTAL ADJUSTED SAVINGS		$1,512	$1,047	$1,047	$465	26.13%	$66	6.32%			$561	31.51%	$578	32.45%	12.8

Appendix C

Project Data for NAVFAC Training Range Projects

TRAINING RANGE PROJECTS USING "NEWPORT DESIGN/BUILD "

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	# Months
86	Cecil Field NAS	Air Combat Traing Range	$1,200	$1,054	$1,054	$146	12.17%	$0	0.00%			$146	12.17%	07/01/87	03/10/88	8.3

TRAINING RANGE PROJECTS USING STANDARD METHOD

FY	ACTIVITY	PROJECT TITLE	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	# Months
92	Cherry Point NC, MCAS	Aircraft Bombing Range	$1,450	$1,620	$1,641	($170)	-11.72%	$21	1.30%			($191)	-13.17%	09/02/92	10/31/93	25.9

** 12 months have been added to the # Months for completion column to account for the time to award to an A/E and Design in standard method.

AVERAGE NET SAVINGS USING "NEWPORT DESIGN/BUILD" METHOD

NEWPORT DESIGN/BUILD	($000) Prg Amt	($000) Award	($000) Fin Cost	($000) Savings	% Savings	($000) Growth	% Growth	A/E Contract	In-House Cost	($000) Net Saved	Net % Saved	Date Awarded	Date Completed	Months Saved
TOTAL ADJUSTED SAVINGS	$1,341	$1,054	$1,054	$287	23.89%	$14	1.30%			$304	25.34%			17.6

Appendix D

NAVFAC ENGINEERING FIELD DIVISIONS

Appendix E

ASCE Summary of Federal Agency Design/Build Survey

APPENDIX
SURVEY OF FEDERAL AGENCIES USING DESIGN-BUILD PROJECT DELIVERY*

	U.S. Army Corps of Engineers	U.S. Navy NAVFAC	U.S. Air Force The Civil Engineer	Department of Veterans Affairs	Department of State	General Services Administration	Environmental Protection Agency	National Aeronautics and Space Administration	Federal Highway Administration	U.S. Postal Service
Total Value of Construction FY 1991	$3.38 billion - MILCON $1.35 billion - Civil Works	$1 billion - MILCON $126 million–Family Housing	$854.8 million	$352.6 million	$270 million	$1.719 billion	$172 million	$498 million	$7.363 billion (federal share - new design and construction)	$1.5 billion
Percentage ($ spent) using Traditional Project Delivery 1991	98% - MILCON 100% Civil Works	99.9% - MILCON 23% Family Housing	94.8%	100%	79%	67%	3%	93%	100%	78%
Percentage ($ spent) using Non-Traditional (Design-Build, Turn-key, etc.) 1991	2% - MILCON 0% - Civil Works	.01% - MILCON 77% Family Housing	5.2%	0% (DoVA Used Design-Build in 1990, and again in 1992)	21%	33%	97%	7%	0% (FHWA funding may be used for privatized toll road in 1992)	22
Does Agency Expect Design-Build to Increase over the next two years?	Yes, as permitted by PL 101-307	Yes, if activities experience success with design-build	Yes	Yes	Possibly	Growth to be determined	Most EPA projects are already using non-traditional delivery	Yes	With special experimental project No. 14, FHWA is trying out innovative contracting practices	Moderate growth in [illegible] build is expected
Design-Builder Qualification Procedure	Varies by project type, funding source, design requirements	Vary according to project type, contracting officer decisions	Offeror responds to CBD announcement	Initial design by OBS; selection by competitive negotiation	Prequalification as required in PL 99-399	With two-phase process, Phase I includes technical and price analysis information; firms are then selected to participate in Phase II with technical proposal, concept design and price	Offeror responds to CBD announcement	Offeror responds to CBD announcement		General notice to [illegible] offerors in CBD [illegible] prequalification [illegible] CBD to select [illegible] highly qualified firms
Design-Build Offeror Selection Factors	Varies by project type, design requirements	Varies by Contracting method	Related firm experience, key individuals experience, design-contractor, relationship, cost	Price, qualifications of firm, qualifications of individuals	Price plus technical factors	Technical factors, price, past performance, projected life cycle costs	Varies by project type, determined by contracting officer	Technical management, key personnel, past experience, cost, corporate resources		[illegible] including [illegible] personnel, experience, performance, safety [illegible]
How are Selection Factors Weighted	Varies by project type, design requirements	Price is a factor, along with technical considerations	Experience, working relationship, cost	Varies with project	Price, then technical factors	Selection based on greatest total value: initial cost, life cycle cost, technical factors	Varies by project type, technical and price factors	Numerical scale as stated in CBD announcement		Relative importance [illegible] above factors is found [illegible] notice. USPS seeks greatest value
Percentage of Design Complete at Award to Design-Builder	0% to 35%, varies by project type	Generally 20% to 30%	30% to 40%	20% to 50%	0% to 35%	0% to 30%	Varies by project type	20% to 30%		0% to 30%
Does Agency Offer Reimbursement to Unsuccessful Offerors	No	No, but bid and proposal costs for successful offeror may be negotiated as indirect expenses	No, but offeror effort is kept to a minimum	No, because owner carries design further through design process	No, but concept is under consideration	Not usually, but stipends may be used in two-phase process	No	No	Not Applicable	No
Type of Contract, Used with Design-Build Approach	One-step turnkey	Firm fixed price	Fixed price, not to exceed	Firm fixed price	Firm fixed price; or reimbursement for design and fixed price construction	Fixed price and fixed price incentive	Cost reimbursement	Cost plus fixed fee, fixed price, fixed price plus shared incentive		Guaranteed max[illegible] with share saving [illegible] as incentive to con[illegible]
Types of Projects for Which Design-Build is Currently Used	Educational Facilities, Maintenance/warehouse facilities, family housing	Parking structures, water treatment plants, family housing, wharf facilities, child development centers, etc.	Sophisticated (cryptology center) to simple (dormitory)	Hospitals, clinics, temporary buildings, parking garages	Embassy chanceries and other facilities	Government Office Buildings and related facilities	Hazardous waste remediation	Technical facilities, office buildings, visitor centers, storage/warehouse	See TRB Circular No. 386 "Innovative Contracting Practices" Dec 1991	Postal facilities [illegible] and major renovation[illegible]
Additional Comments	Corps is developing architectural and engineering instructions (AEI) on turn-key	Navy is experimenting with "Newport Design-Build" to obtain simple projects via sealed bidding		Less in-house man-hours needed to review design-build projects, more in-house hours needed to set up design criteria and do selection		GSA Design-Build RFP Guide Published November 1991			States of California, Michigan and Missouri have indicated a strong interest in design build	

* Surveys were sent to 19 federal agencies. Four agencies that reponded to the survey are not currently using design-build. Five agencies did not respond to the survey.

Appendix F